Appendix Y OCAP BA- Delta Fish Agreement

Appendix to Delta Fish Agreement OCAP BA Materials in Chapter 18

Delta Fish Agreement Summary

Introduction and Background: Delta Pumping Plant Fish Protection Agreement

On December 30, 1986, the Directors of the California Department of Water Resources (CDWR) and the California Department of Fish and Game (CDFG) signed an agreement to provide for offsetting direct losses of fish caused by the diversion of water at the Harvey O. Banks Delta Pumping Plant (Delta Pumping Plant). The Agreement is commonly known as the Delta Fish Agreement. Because it was adopted as part of the mitigation package for four additional pumps at the Delta Pumping Plant, it has also been referred to as the Four Pumps Agreement. The 1986 Delta Fish Agreement offsets direct losses of striped bass, Chinook salmon, and steelhead. Among its provisions, the Delta Fish Agreement provides for the estimation of annual fish losses and mitigation credits, and for the funding and implementation of mitigation projects. The Agreement gives priority to mitigation measures for habitat restoration and other non-hatchery measures to help protect the genetic diversity of fish stocks and reduce over reliance on hatcheries. The 1986 Delta Fish Agreement indicates that mitigation for project effects may be quantified in smolt or yearling "equivalents," or may be unquantified recognizing that some benefits are not measurable. In the case of Chinook salmon, priority is given to salmon protection measures in the San Joaquin River system.

The 1986 Delta Fish Agreement has been amended three times to extend the period for expenditure of the $15 Million Lump Sum funding component of the original Agreement, with the most recent extension through December 2007. The other funding component of the Agreement is the Annual Mitigation funding, which has no termination date. Since 1986, approximately $60 million in combined funding from the Annual Mitigation and $15 Million Lump Sum components have been approved for over 40 fish mitigation projects through December 2007. About $47 million of the approved funds have been expended to date and the remaining approved funds are allocated for new or longer term projects. Examples of the types of projects that are ongoing, have been completed, or will be implemented in future years that are funded under the existing 1986 Delta Fish Agreement are: fish screens in Butte Creek, San Joaquin River tributaries, and Suisun Marsh; enhanced law enforcement projects to reduce illegal harvest in the Bay-Delta and upstream in the Sacramento-San Joaquin basins; a seasonal fish barrier on the San Joaquin River; fish ladders in Butte Creek; cost-share funding for Chinook salmon production at the Merced River Fish Hatchery; habitat enhancement and river restoration projects in San Joaquin River tributaries and the upper Sacramento River; and water exchange projects on Deer Creek and Mill Creek.

The 1986 Delta Fish Agreement Article V, Paragraph B states measures to offset direct losses for fish species not targeted by the original Agreement shall be included when more information is obtained to develop effective measures, and provides for the addition of other species to the Agreement. Article VII of the Agreement directs CDFG and CDWR to develop ways to offset the adverse impacts of the State Water Project (SWP) to fish not addressed in the Agreement, and provides for the resolution of indirect impacts to fish through the existing Agreement.

Description of Delta Fish Agreement 2008 Amendment

On May 7, 2007, CDWR and CDFG entered into a Memorandum of Understanding (MOU) in order to facilitate and expedite completion of the reinitiated consultation of the federal Biological Opinions (BiOps) on the coordinated SWP and Central Valley Project (CVP) operations, commonly referred to as the Operations Criteria and Plan (OCAP). In Paragraph 7 of the MOU, the parties agreed to begin negotiations to amend the 1986 Delta Fish Agreement to "at least address direct and indirect take of delta smelt and indirect take of salmon and methods to develop mitigation credits for this take."

CDWR and CDFG are finalizing the 2008 Amendment to the Delta Fish Agreement between CDWR and the CDFG (hereafter "2008 Amendment"), and anticipate that the Amendment will be executed prior to the issuance of the OCAP BiOps. The mitigation actions currently identified in the draft 2008 Amendment are described in this section as "conservation actions" for the OCAP Biological Assessment and subsequent BiOps issued by U.S. Fish and Wildlife Service (USFWS) and NOAA National Marine Fisheries Service (NMFS). The Amendment sets forth the process which will be used to identify and implement actions to preserve species (hereafter "conservation actions"), and requiring specific evaluations, acceptance, progress review, timing and financing of conservation actions. The Amendment acknowledges that the impact estimates and mitigation requirements will be refined based on the actual Export/Inflow ratio parameters set in the BiOps issued by USFWS and NMFS and that details concerning some of the identified conservation actions that have been identified may be modified or refined; and new conservation actions may be proposed.

The draft 2008 Amendment identifies actions, including habitat restoration, for the preservation of Sacramento River winter-run Chinook salmon (hereafter "winter-run Chinook Salmon"), Central Valley spring-run Chinook salmon (hereafter "spring-run Chinook salmon"), delta smelt, and longfin smelt to address impacts by the operation of the Harvey O. Banks Delta Pumping Plant, Clifton Court Forebay, Skinner Fish Facility, and Barker Slough Pumping Plant (collectively, "SWP Delta Pumping Facilities").

CDWR and CDFG agree that SWP Delta Pumping Facilities cause direct losses of some species other than those specifically listed in the original Agreement and also cause indirect losses. Pursuant to Article V and VII of the 1986 Agreement, under the 2008 Amendment CDWR will mitigate for direct and indirect losses of winter-run Chinook salmon, spring-run Chinook salmon, delta smelt, and longfin smelt (referred to hereinafter as "target species") caused by the SWP Delta Pumping Facilities. Measures provided under this Amendment may also benefit non-target fish species.

In the current draft of the 2008 Amendment to the Delta Fish Agreement, CDWR would provide direct and indirect benefits to the target species through restoration of aquatic habitat in the Delta and Suisun Marsh, in the amount determined by the CDFG methodology described in the CDFG Rationale for Effects of Exports, to mitigate for impacts to surface acres of aquatic habitat in the Delta determined to have been impacted by the SWP Delta Pumping Facilities. CDWR will also provide direct and indirect benefits to the anadromous target species through funding of mitigation actions described in this section, or equivalent actions, as determined by CDFG.

The formula developed by CDFG to determine the amount of Delta and Suisun Marsh mitigation acreage needed under the Amendment on a particle tracking study done by Kimmerer and Nobriga (2008) as documented in the CDGF Staff Report on Rationale for Effects of Exports (Kratville). The analysis assumes habitat for pelagic species include open channel and other associated aquatic and intertidal areas that are utilized by various life history stages of pelagic fish species and for food production. The analysis was based on flows that result in an Export/Inflow (E:I) Ratio of 0.35 that occur during Feb 1- June 30, which is the E:I Ratio required by Decision 1641 during that time period. For example, if you assume an E:I ratio of 0.35 in the formula, then 21,885 surface acres is the amount of habitat restoration needed to offset the impacts of SWP Delta exports. In other words, this is the acreage considered by CDFG to be impacted as long as combined diversions continue at an E:I ratio of 0.35.

Based on the Rationale for Effects of Exports Report, the SWP Delta Pumping Plant averaged 55.18% of combined exports from 2001 through 2006[1]. Applying this pumping share of exports to the 21,885 affected surface acres equates to 12,076 surface acres of aquatic habitat impacted as a result of the SWP exports.

The actual E:I ratio used to determine the amount of aquatic habitat in the Delta and Suisun Marsh required by CDFG as mitigation pursuant to this Amendment will be determined by the final OCAP BiOps issued by USFWS and NMFS and is expected to be up to 0.35. Therefore, based on the DFG analysis, the estimated range of mitigation acreage would be up to 12,076 acres.

Commitments, Timing, and Financing

CDWR and CDFG are finalizing the 2008 Amendment. As per the current draft of the 2008 Amendment, CDWR and CDFG shall work together, in coordination with the USFWS and NMFS, to implement accepted conservation actions using a phased approach to ensure funding and implementation of actions (Year One), and to provide for the funding and development of additional actions (Years Two to Ten). CDFG will use the process outlined in the *Evaluation, Acceptance and Progress Review of Conservation Actions* section below to accept conservation actions. As currently anticipated in the 2008 Amendment, to immediately start mitigation to restore habitats needed to provide sufficient nutrient production, spawning and rearing for target species, during Year One, CDWR will fund, plan, and implement to the extent practicable the early implementation actions chosen by CDWR and CDFG, at an estimated cost of $36 million. These early implementation actions include, but are not limited to, protection and restoration of

[1]This 55.18% includes the portion of CVP water exported through the SWP Banks Pumping Plant.

the Cache Slough Complex with an initial focus on Prospect and Liberty Islands, a fixed cost contribution to the Battle Creek Restoration Project, restoration of Hill Slough West Tidal Marsh, and a one-time contribution to the Delta Smelt Refugium Culture Facility. These actions, which are described in greater detail under *Early Implementation Actions* below, will be part of the Year One commitments with a funding commitment of $36 million. These actions will be subject to final agreement on the 2008 Amendment to the Delta Fish Agreement by CDWR and CDFG, CDFG acceptance of these actions, and completion of all necessary environmental review and permitting. CDWR will also continue funding and implementation of several ongoing annual conservation actions described in detail under *Ongoing Actions* below.

Potential additional conservation actions for Years Two to Ten include, but are not limited to, projects in the Yolo Bypass, Sacramento Basin, the Delta, Suisun Marsh, and Cache Slough Complex that are determined by CDFG to provide direct and indirect benefits to the target species. These actions are also described in greater detail under *Other Potential Conservation Actions* below. These potential additional actions will be identified by CDFG and CDWR with assistance from USFWS and NMFS and submitted for final acceptance to CDFG.

Year One Commitments and Financing

As currently anticipated in the 2008 Amendment, in Year One, CDWR will initiate or continue implementation of conservation actions identified by CDFG and CDWR as early implementation actions. CDWR will also continue funding and implementation of the following ongoing actions, which are annual conservation actions under the existing Delta Fish Agreement: Salmon Stock Ocean Harvest Inland Escapement Data Processing Program; Deer Creek Flow Enhancement Program; Mill Creek Water Exchange Program; Butte Creek Fish Passage Monitoring and Maintenance Program; Spring-run Chinook Salmon Warden Protection Program.

CDWR will initiate or continue early implementation conservation actions identified above (and possibly others), including several ongoing annual conservation actions under the existing Delta Fish Agreement. CDWR will fund the early implementation conservation actions specified above, in Year One, at an estimated cost of $36 million through direct implementation or as cost-share partners in the project. During the first six months, CDFG and CDWR shall develop an Implementation Schedule and Plan that will identify conservation actions, costs, targeted acreage, and a timeline for CDWR's implementation over the term of the Amendment. Pursuant to the 2008 Amendment, plans for individual conservation actions shall include CDWR funding sufficient to accomplish full implementation of the action, which may include restoration planning, environmental review, permitting, interim management prior to restoration, restoration implementation, operation and maintenance activities, and monitoring to evaluate project success in meeting the planned restoration objectives.

Years Two through Ten Commitments and Financing

As currently anticipated in the 2008 Amendment, in Years Two through Ten, CDWR will work with CDFG to initiate or continue implementation of conservation actions identified by CDFG in Year One and through the Implementation Plan and Schedule. CDWR and CDFG will follow the Implementation Plan and Schedule to mitigate the impacts to in-Delta aquatic habitat until the required mitigation acreage is met. Pursuant to the 2008 Amendment CDWR will reimburse CDFG's staffing costs to plan and implement mitigation actions including tracking compliance

with the Implementation Schedule, negotiating land transfer agreements, managing transferred lands, assessing and evaluating results, and helping develop adaptive management plans.

Evaluation, Acceptance and Progress Review of Conservation Actions

The conservation actions, including but not limited to those described in *Early Implementation Actions, Ongoing Actions,* and *Other Potential Conservation Actions* below, will be identified by CDFG and CDWR with assistance from USFWS and NMFS and submitted for final acceptance to CDFG. Conservation actions could include any of the following, subject to the process outlined below: Ecosystem Restoration Program (ERP) Directed Actions; Ecosystem Restoration Program Proposal Solicitation Process (PSP); CDWR sponsored projects; purchase of credits at mitigation banks; cost-share projects or other actions mutually agreed upon by CDWR and CDFG. CDWR and CDFG will comply with the California Environmental Quality Act (CEQA) for proposed projects under the Amendment. The process for accepting, implementing, and reviewing conservation actions is outlined below.

A. Conservation Action Development and Evaluation Process:

1. Conservation actions will be developed by CDFG and CDWR in cooperation with USFWS, NMFS, and other responsible regulatory agencies.

2. CDFG and CDWR shall evaluate each proposal following the guidelines set forth in the Agreement and the criteria set forth in Section B below.

3. Proposed conservation actions will be evaluated using the Delta Regional Ecosystem Restoration Implementation Plan (DRERIP) conceptual models and peer reviewed through the ERP Directed Action Process.

4. Proposed mitigation actions will be submitted to the Delta Fish Agreement Advisory Committee for review and comment.

5. Proposed mitigation actions may be modified by input which includes, but is not limited to, that from the public, the Delta Fish Agreement Advisory Committee, or the DRERIP evaluation.

6. The finalized proposal will be submitted to CDFG for acceptance of the proposed mitigation action.

B. Criteria: CDFG will accept mitigation actions using the following process and criteria:

1. Aquatic habitat actions in the Delta and Suisun Marsh, primarily for the benefit of pelagic target species, that will focus on restoration of intertidal, shallow subtidal, floodplain, and adjacent open water habitats. The acres of habitat restored or enhanced are expected to provide both direct and indirect benefits by enhancing spawning and rearing habitat, increasing primary and secondary productivity in the Delta, and providing export of nutrients to adjacent openwater habitats. These habitat actions are expected to mitigate for productivity impacts which occur as a result of SWP Delta Pumping Facilities exports and support higher larval and juvenile fish survival and increased fitness of spawning adults by improving conditions for the production of forage species. Restored intertidal or shallow subtidal habitats will be expected to: a) provide net export of nutrients to adjacent open water (pelagic) habitat; b) have appropriate hydrodynamic and/or salinity and water quality characteristics to minimize or discourage invasion by non-native submerged aquatic vegetation (*e.g. Egeria*) and *Microcystis* blooms; and/or c) function as spawning and/or rearing habitats for the target species; and d) be located in areas not subject to the near-field effects of SWP Delta Pumping Facilities.

2. Conservation actions primarily for the benefit of the salmonid target species includes, a) provision of flows in tributary streams to enhance upstream passage, over-summering, spawning and rearing habitat, b) barrier removal which improves access to suitable habitat described above, and/or c) restoration of functional stream geomorphology and floodplain which provides spawning habitat and rearing habitat for out-migrating smolts. These actions are expected to increase available spawning habitat, improve over-summering adult survival, increase spawning success, and increase juvenile survival and fitness.

3. CDFG will use its Habitat Management Land Acquisition Checklist to evaluate the acceptability of any property to be transferred as part of its consideration of the proposed conservation action.

C. Review of Progress – CDFG will monitor for the effectiveness of the conservation actions towards meeting the criteria in Section B, as follows:

1. The results of mitigation actions will be evaluated by an independent science panel or advisor as agreed to by CDWR and CDFG at Years Five and Eight of the Amendment, or earlier if necessary, in order to determine if the mitigation actions are meeting intended mitigation criteria for target species.

2. CDFG, in coordination with CDWR, will review implementation of mitigation actions after Year Four of the Amendment and each two years thereafter, to determine progress towards achieving mitigation acreage.

3. If the review of progress indicates that mitigation actions are not performing adequately, CDWR and CDFG will implement adaptive management measures as necessary.

D. Mitigation Acreage:

1. As part of its review and acceptance of each conservation action, CDFG will determine the amount of acreage to be credited to CDWR. The amount of acreage credit will be based upon the criteria in Section B (above) and the evaluation conducted in Section A (above).

2. For cost-share conservation actions, acreage credit will be pro-rated based on CDWR's funding contribution towards the implemented action. CDFG will determine the pro-ration of acres by using the percentage of funding contributed towards the conservation action by CDWR through this Amendment. Or if the action contains distinct elements, CDFG will credit the acreage of those elements to the extent funded by CDWR through this Amendment. For each individual conservation action, CDFG will determine the appropriate method of pro-ration based on which method is more beneficial to the resource.

E. Notwithstanding the foregoing, DFG may accept proposals for mitigation from DWR without reference to the process and criteria set forth above, upon DFG first determining in its sole discretion that circumstances regarding the status of the target species warrant such action. Such mitigation may include, without limitation, the funding of actions or the provision of assets, provided that DFG determines that the action or assets will provide mitigation benefit to the target species. In such event, DFG will credit mitigation acreage to DWR in the amount determined to correspond to the mitigation benefit provided. DFG will advise DWR of the amount of acreage to be credited prior to the funding or implementation of the action.

Description of Potential 2008 Amendment-Conservation Actions

Potential conservation actions to be implemented pursuant to the 2008 Amendment fall into three categories:

1. Early Implementation Actions
2. Ongoing Actions
3. Other Potential Conservation Actions

Each specific conservation action proposed pursuant to the 2008 Amendment will undergo its own project-specific section 7 consultation. A project-specific Biological Assessment will be prepared for each specific action. During the preparation of these Biological Assessments, the applicants will undertake the standard practice of researching background information on specific listed species and designated critical habitat present within the action area of that specific project, conducting habitat assessments and surveys as appropriate, and proposing impact avoidance and minimization measures for individual listed species that are, or may be, present. To document that CDWR will take the appropriate steps to avoid and minimize adverse effects on the target species and designated critical habitat, Best Management Practices (BMPs) have been identified. Because these conservation actions are intended to benefit winter-run Chinook salmon, spring-run Chinook salmon, delta smelt, and longfin smelt, their long-term effects on these and other fish species will be overwhelmingly beneficial. Nevertheless, BMPs to reduce short-term adverse effects on these target species will be implemented. In addition, BMPs will be implemented to avoid and minimize adverse effects on terrestrial and wetland species that may currently inhabit areas where 2008 Amendment conservation actions are proposed. A list of BMPs is provided under the section *Best Management Practices* below. Because BMPs will vary by species, and the listed/proposed species in question will vary by geographic location and habitat of the conservation area, not all BMPs apply to all conservation actions. Therefore, BMPs are grouped by the potential effect that they are intended to help avoid, and in the project descriptions below, the applicable BMPs are listed.

Action Area

The specific locations of the early implementation actions that have already been identified, and of the ongoing actions, are well known. The locations of some of the other potential conservation actions are known only generally (*e.g.*, "the Yolo Bypass"), and it is possible that some of the conservation actions to be implemented according to the 2008 Amendment have not yet been conceived. Nevertheless, the general action area for the known and potential conservation actions has been identified.

The action area includes the locations of all areas that will be affected by conservation actions pursuant to the 2008 Amendment. Most of these locations are in diked wetlands within the Suisun Marsh, the Delta (particularly in the Cache Slough area but also potentially including other locations), and the Yolo Bypass. Such areas include the following, as well as other potential conservation locations:

- In the Cache Slough complex:
  - Prospect Island Tidal Marsh Restoration Project
  - Liberty Island Tidal Marsh Restoration Project
  - Western Cache Slough Complex
  - Little Holland Tract
  - Eastern Egbert Tract

- In the Suisun Marsh:
  - Hill Slough West Tidal Marsh Restoration Project
  - Meins Landing Tidal Marsh Restoration project area

- In the Yolo Bypass:
  - Lower Putah Creek Re-Alignment area
  - Lisbon Weir
  - Additional Multi-species Floodplain Habitat Development areas
  - Tule Canal Conductivity area
  - Fremont Weir Fish Passage area

Within these general areas, the action area includes the immediate locations of conservation construction activities, including all lands that will be subject to changes in hydrology (*e.g.*, those that will be inundated by tidal waters or subject to more frequent flooding) or otherwise altered as a result of breaching and tidal restoration; areas immediately adjacent to the locations of conservation action construction activities, and areas along access roads leading to the conservation action locations, which could be directly and indirectly affected by project construction; and areas both upstream and downstream from conservation action locations, which could be affected somewhat by sediment mobilization and turbidity during and immediately following breaching and by scour and changes in sedimentation patterns for longer periods following restoration of tidal action.

The action area also includes the locations of discrete activities that will be performed pursuant to the 2008 Amendment in areas outside the Suisun Marsh, the Delta, and the Yolo Bypass. These areas include:

- The Delta Smelt Refugium Culture Facility in Byron, California.
- The Battle Creek Salmon and Steelhead Restoration project in Shasta and Tehama Counties near the town of Manton, California. The upper project limit on North Fork Battle Creek is the absolute natural fish barrier above North Battle Creek Feeder Diversion Dam, 14 miles upstream of the confluence. The upper project limit on South Fork Battle Creek is the natural fish barrier above South Diversion Dam. The lower project limit is 9 miles upstream of the confluence of Battle Creek and the Sacramento River at a location just below the confluence of Coleman Powerhouse tailrace channel and the mainstem of Battle Creek. Restoration efforts would occur at Hydroelectric Project sites along North Fork and South Fork Battle Creek and their tributaries,

including North Battle Creek Feeder, Eagle Canyon, Wildcat, Coleman, Lower Ripley Creek Feeder, Inskip, Soap Creek Feeder, and South Diversion Dams; the Eagle Canyon, Wildcat, Inskip, and South Canals; and the Inskip and South Powerhouses.

- The Deer Creek Flow Enhancement Program area, which includes the reach of Deer Creek from the existing Deer Creek Irrigation District Dam at the north end of Reed Orchard Road, northeast of Vina in Tehama County, downstream to the confluence with the Sacramento River, as well as approximately 25 miles of Deer Creek upstream from the dam that will be more easily accessed by salmonids as a result of the project.
- The Mill Creek Water Exchange Program and Mill Creek Water Right Opportunities project areas, which include the lower reaches of Mill Creek (roughly from the east side of the Sacramento Valley floor downstream to its confluence with the Sacramento River), north of Los Molinos in Tehama County. These projects' action areas also include the locations of wells on The Nature Conservancy's (TNC's) Dye Creek Preserve, and upstream reaches of Mill Creek that will be more easily accessed by salmonids as a result of the project.
- The Parrott Phelan and Durham Mutual Dams, and their associated fish ladders and screens, which are located along Butte Creek southeast of Chico in Butte County, California. The action area for this project also includes upstream reaches of Butte Creek that will be more easily accessed by salmonids as a result of the project.
- The Spring-run Warden Overtime project area, which involves the work of CDFG wardens on Mill, Deer, Antelope, Butte, Big Chico, Cottonwood, and Battle Creeks, as well as the Sacramento, Yuba, and Feather Rivers.

The Action Area Maps, (Figures A and B below on page 57 and 58 respectively), depict the action areas for the 2008 Amendment conservation actions.

Early Implementation Actions

The early implementation actions include new (*i.e.*, not ongoing) actions which will be implemented in Year One in order to immediately initiate mitigation to restore habitats needed to provide sufficient nutrient production, spawning and rearing for winter-run Chinook salmon, spring-run Chinook salmon, delta smelt, and longfin smelt. Five early implementation actions, described below, have been identified, though others may be identified as well.

Prospect Island Tidal Marsh Restoration

Project Location. Prospect Island is the most easterly feature of the Cache Slough Complex, located in the northwestern part of the Sacramento-San Joaquin Delta in Solano County. The island is bounded by the Sacramento River Deep Water Ship Channel (ship channel) to the west, a remnant of Little Holland Tract to the north, Miner Slough to the east, and the confluence of the ship channel and Miner Slough to the south.

Project Components. The Prospect Island Tidal Marsh Restoration project entails permanently breaching the levees on Prospect Island to restore up to 1692 acres of open water, tidal marsh, mudflats, and shaded riverine aquatic habitat would provide spawning and rearing habitat for

delta smelt and Sacramento splittail, and rearing and migration habitat for winter-run Chinook salmon (U.S. Army Corps of Engineers and CDWR 2001).

Prospect Island was acquired by the Federal Government (through the Bureau of Reclamation) with a goal to "restore wetlands and fisheries" as described in the House Reports accompanying the Energy and Water Development Appropriations Acts of 1994 and 1995. This island offers a unique opportunity for restoration due to minimal subsidence, which has left elevations in the island interior ranging from +1 to –5 feet msl. Therefore, when flooded, water depths would be suitable for supporting tidal wetlands including marsh, mudflats, and shallow water habitats. These habitats are relatively rare in the Delta, and the opportunities for restoring them are limited.

The Cache Slough area, in which Prospect Island is located, has become an important focus for restoration activities in the north Delta to increase and improve the overall habitat for delta smelt. This area has the highest feasibility tidal marsh restoration in all of the Delta due to the least subsidence, proximity to the highest Delta sediment supply, connection to extensive lowland grasslands, and proximity to Yolo Bypass, the Sacramento River, and the Suisun Marsh. Because the most prevalent population of delta smelt occurs in this region of the Delta, monitoring of species and system response to the project is necessary to manage changes.

In addition to breaching of existing levees and excavation of internal channels, the design includes the construction, under dry conditions, of berms along the interior slopes of existing perimeter levees to add stability to these levees and to provide wildlife habitat. Some levee sections along the ship channel already have gradual slopes and would require no additional protection. The proposed project includes islands that have been designed to reduce fetch lengths and associated wind-generated waves and thereby to help protect the levees surrounding the project. The islands would also provide wildlife habitat. Selected constructed berms and islands would receive plantings.

The construction period would be followed by a 3-year plant establishment period. After construction, CDWR would monitor fish, wildlife, vegetation, water quality (including temperature), zooplankton, phytoplankton, benthos, bathymetry, and organic carbon.

The expected outcomes of the project are: (1) a mosaic of evolving habitats supporting numerous species at a significant scale; (2) connection to the Yolo Bypass, Sacramento River, and Suisun Marsh; (3) increased food supply for fish, birds, and marine mammals; (4) landward migration of intertidal marsh over time; (5) reduced water treatment needs; and (6) improved hydraulics so fish can reach habitats and primary production can reach the Sacramento River. Large quantities of plankton and detritus produced by the tidally influenced wetlands would support forage on-site as well as within the Sacramento-San Joaquin Delta (via tidal action transport). Other benefits include increased oxygen levels and the absorption of excess nutrients by sediments and emergent plants resulting from the high surface-to-volume ratio of the shallow wetlands. The project will accommodate sea level rise to maintain functions of the conservation area over the long term.

Applicable BMPs. The timing of all breach work on the outboard side of Miner Slough levee areas would be limited to a construction window between August 1 and November 30 due to endangered species constraints. Breach work would be phased to maximize construction in the dry before actual breaching. After breaching, the remaining excavation work and placement of rock protection would be scheduled to tidal cycles to minimize in-water work. All work would be in conformance with the National Pollution Discharge Elimination System criteria and other environmental protection requirements.

In addition, the following BMPs will be implemented (see *Best Management Practices* below):

- General
- Aquatic and Wetland Species/Water Quality
- Valley Elderberry Longhorn Beetle
- Giant Garter Snake

Liberty Island Tidal Marsh Restoration

Project Location. Liberty Island lies within the Yolo Bypass and is part of the Cache Slough Complex. It spans Yolo and Solano Counties and covers approximately 5200 acres, the majority of which are under water. The island is bounded by sloughs and remnant perimeter levees: Shag Slough on the west, a "stair step" channel that separates it from mainland Yolo Bypass to the north, the Liberty Cut and Prospect Slough to the east, and Cache Slough to the south. The Liberty Island Tidal Marsh Restoration project area occupies approximately 1500 acres.

Project Components. The Liberty Island Tidal Marsh Restoration project entails permanently breaching the levees on Liberty Island to restore up to 1500 acres of open water, tidal marsh, mudflats, and shaded riverine aquatic habitat would provide spawning and rearing habitat for delta smelt and Sacramento splittail, and rearing and migration habitat for winter-run Chinook salmon, and may also provide benefits to longfin smelt.

Liberty Island is ideal for tidal wetland restoration due to the minimal subsidence that has occurred on the island, with typical interior island elevations ranging from 5 feet in the north to -10 feet or deeper in the south. Restoration would consist mostly of passive restoration approaches that would allow wetland and riparian vegetation to establish naturally. The whole island is ringed with an intermittent (deteriorated) levee. Based on the current progression of the single primary northern breach in the central "stair" of Liberty Island, additional breaches in the other two "stairs" and the subsequent formation of tidal channels and sloughs could accelerate the restoration of the island. Within the ten years that the island has been flooded, over 800 acres of freshwater tidal marsh and tules have developed, without any human intervention, management, or funding. Aiding recovery of the area by creating additional breaches in the northern levees would enhance the tidal marsh and mudflat habitats at minor expense to riparian habitat quantity.

Design options might range from simply breaching the northern levee "steps" and allowing subsequent floods and tidal action to bring about the development of slough and island features, to giving tidal marsh channels a head start by excavating starter channels. Naturally forming or created meandering sloughs could improve habitat quality, improve native fish access, and help prevent stranding. Filling agricultural delivery and drainage ditches and leveling the existing road bisecting the property are also possible actions. Additional design features might be included to ease issues such as wind-wave erosion on adjacent levees.

The middle staircase, which is hydraulically connected via a breach to the rest of Liberty Island, has a wide range of marsh habitat, tules, cattails, mudflats, and deeper channels. The other two stair steps are dry most of the year and are covered in pepperweed and other weedy vegetation. By breeching these two other stair steps, the area of freshwater tidal marsh could easily be doubled to well over 1500 acres.

After construction, CDWR would monitor fish, wildlife, vegetation, water quality (including temperature), zooplankton, phytoplankton, benthos, bathymetry, and organic carbon.

The expected outcomes of the project are: (1) a mosaic of evolving habitats supporting numerous species at a significant scale; (2) connection to the Yolo Bypass, Sacramento River, and Suisun Marsh; (3) increased food supply for fish, birds, marine mammals; (4) landward migration of intertidal marsh over time; (5) reduced water treatment needs; (6) improved hydraulics so fish can reach habitats and primary production can reach the Sacramento River. Large quantities of plankton and detritus produced by the tidally influenced wetlands would support benthic forage on-site as well as within the Sacramento-San Joaquin Delta (via tidal action transport). Other benefits include increased oxygen levels and the absorption of excess nutrients by sediments and emergent plants resulting from the high surface-to-volume ratio of the shallow wetlands. The project will accommodate sea level rise to maintain functions of the conservation area over the long term.

Applicable BMPs. The timing of all breach work on the outboard sides of existing levees would be limited to a construction window between August 1 and November 30 due to endangered species constraints. Breach work would be phased to maximize construction in the dry before actual breaching. After breaching, the remaining excavation work and placement of rock protection would be scheduled to tidal cycles to minimize in-water work. All work would be in conformance with the National Pollution Discharge Elimination System criteria and other environmental protection requirements.

In addition, the following BMPs will be implemented (see *Best Management Practices* below):

- General
- Aquatic and Wetland Species/Water Quality
- Valley Elderberry Longhorn Beetle
- Giant Garter Snake

Hill Slough West Tidal Marsh Restoration

Project Location. The Hill Slough West Habitat Restoration project is located in northern Suisun Marsh, Solano County and is bounded by State Route 12 to the north, McCoy Creek (Grizzly Island Road) to the east, CDFG-managed wetlands (Pond 3) to the south, and a maintained tidal channel (Whispering Bay) to the west. The site is part of the Hill Slough Wildlife area and is owned and managed by CDFG.

Project Components. The Hill Slough West Habitat Restoration project will restore tidal wetlands and moist grassland habitat to approximately 200-1100 acres of diked seasonal and perennial wetlands in northern Suisun Marsh (CDFG 2005). The wetland restoration will re-introduce tidal action to the site, restoring a transition of perennial aquatic habitat in the deepest areas, low intertidal marsh, high intertidal marsh, and lowland alluvial habitat. The restored habitat will provide rearing and productivity support for delta smelt and Sacramento splittail and rearing, resting, and migration habitat for winter-run Chinook salmon. The desired outcome is a self-sustaining marsh ecosystem created through restoration of natural hydraulic and sedimentation processes and reliance on natural abiotic and biotic succession processes.

The project site is a former tidal brackish marsh and lowland alluvial habitat along the northern edge of Suisun Marsh that currently supports nontidal, seasonally ponded and perennial wetlands, and non-native grasslands. The restoration site is currently diked and drained.

Breaches will be created through the perimeter levees through excavation to open the site to tidal action from surrounding slough. Starter channels will be excavated to create tidal channel habitat. Certain segments of existing levees will be lowered to provide high marsh habitat and will also generate material for improvement and construction of other levees which will provide flood protection of the surrounding area and raising Grizzly Island Road. Approximately 208 acres of restorable habitat occurs on the west side of Grizzly Island Road, but another 900 acres is potentially restorable by elevating the road and allowing tidal action to extend under the roadway. Non-native grasslands above the tidal elevations will be planted with native species. Public use facilities, including parking, site access, a foot trail, and overlooks will also be constructed.

A ten-year monitoring plan for the Hill Slough West Restoration project will have three main objectives: 1) To measure the evolution of key biological and physical characteristics as the site evolves; 2) to identify any adaptive management actions that may be warranted to support the development of the site; and 3) to identify the need for any maintenance actions.

Restoration and reference sites will be monitored for physical processes, vegetative composition and cover, benthic invertebrates, avian diversity and abundance, fish diversity and abundance, and special-status species.

Applicable BMPs. The timing of all breach work on the outboard sides of existing levee areas would be limited to a construction window between August 1 and November 30 due to endangered species constraints. Breach work would be phased to maximize construction in the dry before actual breaching. After breaching, the remaining excavation work and placement of rock protection would be scheduled to tidal cycles to minimize in-water work. All work would

be in conformance with the National Pollution Discharge Elimination System criteria and other environmental protection requirements.

In addition, the following BMPs will be implemented (see *Best Management Practices* below):

- General
- Aquatic and Wetland Species/Water Quality
- Soft Bird's-beak/Suisun Thistle
- Vernal Pool Plants (for Contra Costa goldfields in particular)
- California Clapper Rail (for potential indirect effects)
- Salt Marsh Harvest Mouse

Delta Smelt Refugium Culture Facility

Project Location. The Delta Smelt Refugium Culture Facility is located in Byron.

Project Components. CDWR is working with the USFWS, CDFG, State Water Resources Control Board, and University of California Davis (UCD) to establish a temporary delta smelt refugium at Byron by June 2008. This temporary refugium is urgently needed to assure the conservation of the genetic diversity and continued survival of delta smelt. It is a key and initial component to the development of a long-term delta smelt refugium program identified in the Resources Agency's Pelagic Fish Action Plan, March 2007.

The temporary refugium will be constructed in two phases. The first phase will provide the water, power, tanks and other facilities needed to spawn and hold the young of 16 family smelt groups, or up to 96 multi-family groups in half of an existing CDWR building adjacent to the UCD's existing Fish Conservation and Culture Laboratory. It was essential that this first phase work will be completed by December 2007 to be available before smelt begin spawning in February. The first phase work has been completed.

The second phase will install 20 additional tanks and recirculation system outside the building to rear fish as they grow into adults. This second phase has to be completed by June 2008 to provide additional space for the smelt as they grow into adults.
The construction of the refugium is being undertaken as an emergency response to the alarmingly low numbers of delta smelt being found in the Delta this year and to take advantage of a unique opportunity to use smelt that UCD has already collected from the Delta as the founding stock for the refugium. Over the last 5 years, delta smelt populations have been at or near their lowest levels of record. Monitoring earlier this year suggested the abundance of larval delta smelt may have dropped to only a tenth of the previously lowest recorded level. That sharp decline in larval smelt substantially raised concerns that the species may be at risk of extinction. The temporary smelt refugium is essential to assure the continued existence of the species if it does disappear from the Delta.

The immediate installation of the refugium facilities is also necessary in order to use 1000 smelt that UCD has already collected as the founding stock. UCD originally collected these fish to spawn and produce fish for various research purposes. Their reallocation to the refugium would substantially reduce the number of additional smelt which would need to be collected from the Delta to stock the refugium. CDFG and USFWS are trying to minimize the collection of additional smelt from the Delta because of the impact it may have on the already low population.

UCD's smelt are also especially suited to meet the needs of the refugium because they were collected (1) before the apparent sharp decline in the smelt population last spring, and (2) during one of the rare times when almost all the adult smelt in the system spawned in a rather small area of the Delta. Because of these two factors, UCD's smelt may be one of the most genetically diverse collections of delta smelt we are going to be able to secure to stock the refugium. In order to take advantage of this unique collection of fish, the refugium will to be operational by December before they start their second year of spawning. After that time will be too late to use them, because few of these fish are expected to survive to spawn a third year.

CDWR is working with USFWS and UCD through the USFWS's Delta Smelt Captive Propagation Work Group to establish a permanent smelt refugium to ensure the conservation of the genetic diversity of delta smelt. The refugium would provide the brood stock for a conservation hatchery if and when the state and federal fishery agencies decide it is needed to supplement the remaining wild population of delta smelt or to possibly restock the Delta if the wild population is extirpated. This facility is using wild-born smelt collected in 2006 as its initial founding stock.

Applicable BMPs. CDWR's conservation action pertaining to the Delta Smelt Refugium Culture Facility is limited to contributing funding for the continued operation of this facility. No BMPs for this action are needed.

Battle Creek Salmon and Steelhead Restoration Project (Phase 1)

Project Location. The Battle Creek Salmon and Steelhead Restoration project is located in Shasta and Tehama Counties near the town of Manton, California. The project area consists of the portion of the Battle Creek Hydroelectric Project below the natural fish barriers. The upper project limit on North Fork Battle Creek is the absolute natural fish barrier above North Battle Creek Feeder Diversion Dam, 14 miles upstream of the confluence. The upper project limit on South Fork Battle Creek is the natural fish barrier above South Diversion Dam. The lower project limit is 9 miles upstream of the confluence of Battle Creek and the Sacramento River at a location just below the confluence of Coleman Powerhouse tailrace channel and the mainstem of Battle Creek. Restoration efforts would occur at Hydroelectric Project sites along North Fork and South Fork Battle Creek and their tributaries, including North Battle Creek Feeder, Eagle Canyon, Wildcat, Coleman, Lower Ripley Creek Feeder, Inskip, Soap Creek Feeder, and South Diversion Dams; the Eagle Canyon, Wildcat, Inskip, and South Canals; and the Inskip and South Powerhouses.

Project Components. The purpose of the Battle Creek Salmon and Steelhead Restoration project is to restore approximately 42 miles of habitat in Battle Creek and an additional 6 miles of habitat in its tributaries while minimizing the loss of clean and renewable energy produced by the Battle Creek Hydroelectric Project (Jones & Stokes Associates 2005). The project will be

accomplished through the modification of Hydroelectric Project facilities and operations, including instream flow releases. Habitat restoration would enable safe passage for naturally produced salmonids, including winter-run and spring-run Chinook and California Central Valley steelhead, and would facilitate their growth and recovery in the Sacramento River and its tributaries.

Three alternatives to the proposed project, varying primarily in terms of which, and how many, of six dams would be removed, were evaluated. Ultimately, the Five Dam Removal Alternative, which consists of the following actions, was adopted:

- Wildcat, South, Soap Creek Feeder, Lower Ripley Creek Feeder, and Coleman Diversion Dams would be removed.
- Fish screens and fish ladders would be installed at North Battle Creek.
- Feeder, Eagle Canyon, and Inskip Diversion Dams.
- Tailrace connectors would be installed to convey water directly from the Inskip and South Powerhouses to downstream canals to meet several fishery restoration goals.
- A penstock bypass facility would be replaced at the Inskip Powerhouse.
- Springs along Eagle Canyon, Soap Creek (*i.e.*, Bluff Springs), Ripley Creek, and Darrah Springs areas would release to adjacent stream sections under this alternative.
- Flow measurement weirs would be installed at Asbury Diversion Dam to ensure a minimum release of 5 cfs in Baldwin Creek.

A means to access each project site (*i.e.*, an existing or new access road or trail) would be needed during and after construction.

Specific project objectives were developed to expand on the purposes of the restoration project and to help develop project alternatives. These project objectives are consistent with recovery plans for listed anadromous fish species:

- Restore self-sustaining populations of Chinook salmon and California Central Valley steelhead by restoring their habitat in the Battle Creek watershed and access to it through a voluntary partnership with state and federal agencies, third-party donor(s), and Pacific Gas and Electric (PG&E).
- Establish instream flow releases that restore self-sustaining populations of Chinook salmon and California Central Valley steelhead.
- Remove selected dams at key locations in the watershed where the hydroelectric values were marginal because of increased instream flow.
- Dedicate water diversion rights for instream purposes at dam removal sites.
- Construct tailrace connectors and install fail-safe fish screens and fish ladders to provide increased certainty about restoration components.

- Restore stream function by structural improvements in the transbasin diversion to provide a stable habitat and guard against false attraction of anadromous fish away from their migratory destinations.
- Minimize loss of clean and renewable energy produced by the Battle Creek Hydroelectric Project.
- Develop and implement a long-term adaptive management plan with dedicated funding sources to ensure the continued success of restoration efforts.

The restoration project provides the following modifications to the Hydroelectric Project that would achieve the restoration of ecological processes important to anadromous fish:

- Adjustments to Hydroelectric Project operations, including allowing cold spring water to reach natural stream channels, decreasing the amount of water diverted from streams, and decreasing the rate and manner in which water is withdrawn from the stream and returned to the canals and powerhouses following outages.
- Modification of facilities such as fish ladders, fish screens and bypass facilities, diversion dams, and canals and powerhouse discharge facilities.
- Changes in the approach used to manage the Hydroelectric Project to balance hydroelectric energy production with habitat needs, using ecosystem-based management that protects and enhances fish and wildlife resources and other environmental values using adaptive management, reliable facilities, and water rights transfers, among other strategies.

The monitoring plan for Battle Creek Restoration plan will be developed once an alternative is chosen. A detailed facility monitoring plan, prepared by PG&E in consultation with the other parties to the MOU, will be submitted to the Federal Energy and Regulatory Commission (FERC) as part of the license amendment application for the Five Dam Removal Alternative. The monitoring plan delineates a program related to the Proposed Action's components that expands on typical FERC license monitoring requirements. PG&E would perform and assume the costs for the following facility monitoring:

- Verifying compliance with the FERC license at the various outlet and spillway works for North Battle Creek Feeder, Eagle Canyon, Inskip, and Asbury (Baldwin Creek) Diversion Dams by operating properly calibrated remote-sensing devices that continuously measure and record total flow and the fluctuation of stage immediately below each dam during all operations.
- Identifying debris problems at the fish ladders at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams by operating properly calibrated remote-sensing devices that continuously monitor water surface elevations at the tops and bottoms of the ladders. In addition, PG&E would continuously operate a calibrated automated fish counter or an underwater video camera to document fish movement through the

ladder during the first 3 years of operation or as otherwise agreed upon by the parties to the MOU.

- Identifying instances of plugging at the fish screens at North Battle Creek Feeder, Eagle Canyon, and Inskip Diversion Dams by operating properly calibrated remote-sensing devices that continuously monitor water surface elevation differences on the inlet and outlet sides of the screens. If the monitoring reports a critical malfunction on the screen, the fail-safe feature would shut down the inlet to the canal until the situation has been remedied.

PG&E will perform all the necessary maintenance and replacement on the fish screens, fish ladders, and stream gages as indicated by the monitoring, once Reclamation has released these structures for operation.

Applicable BMPs. The following BMPs will be implemented (see *Best Management Practices* below):

- General
- Aquatic and Wetland Species/Water Quality
- Vernal Pool Plants (if access to construction or monitoring areas will occur near vernal pool habitat)
- Vernal Pool Branchiopods (if access to construction or monitoring areas will occur near vernal pool habitat)
- Valley Elderberry Longhorn Beetle

Ongoing Actions

Ongoing actions include five annual conservation actions, four of which have been initiated under the 1986 Delta Fish Agreement. The fifth, the Salmon Stock Ocean Harvest Inland Escapement Data Processing Program, is not currently part of the Delta Fish Agreement but is included as mitigation under the 2008 Amendment. As part of the 2008 Amendment, CDWR will continue funding and implementation of these ongoing actions.

Salmon Stock Ocean Harvest Inland Escapement Data Processing Program

Project Location. This project involves the collection and compilation of data from recreational and commercial salmon landings at approximately 20 ports between Avila (San Luis Obispo County) and the California/Oregon border from marked salmon that are collected at the Feather River, Nimbus, and Mokelumne River hatcheries, and by various escapement monitoring programs throughout the Central Valley.

Project Components. CDWR uses SWP funds to pay for the Salmon Stock Ocean Harvest Inland Escapement Data Processing Program. This SWP Funding helps to support the fish tag program with CDFG and Pacific States Marine Fisheries Commission (PSMFC).

The CDWR Feather River fish studies were initiated in the early 1990s to document and monitor fish populations in the lower Feather River. The program has progressively expanded since the mid-1990s. Elements of the Feather River fish studies include: annual spawning surveys to document natural spawning populations of salmon and California Central Valley steelhead in the lower Feather River; calculating straying indices for salmon produced by the Feather River Hatchery; and assessment of the contribution of hatchery-reared Chinook salmon to the Feather River.

The primary goal of the CDFG's Salmon Management Project is to provide the data and analyses needed to manage California's ocean salmon fisheries on a sustainable basis. Tasks of the Salmon Management Project include: collecting the fishery-dependent data needed to estimate the catch and effort of California's commercial and recreational ocean salmon fisheries; retrieving and reading coded-wire-tags (CWT) from salmon heads recovered by inland escapement monitoring programs and by CDFG programs that sample the ocean salmon fisheries; creating and maintaining databases for CWT data; and uploading California's ocean and inland salmon CWT recovery files, catch-sample, and catch-effort to the Regional Mark Information System (RMIS, a cooperative program of the west coast states that is managed by PSMFC) for use by all stakeholders and agencies.

The interagency agreement and contract provide funding to the CDFG to assist CDWR with evaluating the contribution of Feather River salmon stocks to the ocean salmon fisheries and to salmon escapement in the Central Valley. Under the interagency agreement, the CDWR will provide funds to CDFG to support: one Associate Biologist who will direct the CDFG CWT laboratory and the creation and uploading of California's ocean and inland salmon CWT recovery files, catch-sample, and catch-effort to the RMIS; one Scientific Aid to help Feather River Fish Hatchery recover and document CWT salmon returning to the hatchery; some of the cost of operating the CDFG CWT laboratory; and travel and supplies for collection and processing of salmon heads.

This project, which is performed by CDFG in partnership with the PSMFC, includes the following studies.

1. Contribution of Chinook Salmon from the Feather River to the Ocean Fisheries, 2007 to 2009

   Objective: Determine the contribution (number of fish and expansion factors) of Chinook salmon stocks from the Feather River to the recreational and commercial ocean salmon fisheries.

Procedures: The CDFG programs that sample recreational and commercial salmon landings will collect the heads of marked salmon (*i.e.*, salmon with the adipose fin removed) at approximately 20 ports between Avila (San Luis Obispo County) and the California/Oregon border. The CDFG programs that sample the landings are not supported by this cooperative agreement; they are funded by other state and federal sources. Staff from CDFG will transport the heads to the CDFG CWT laboratory for processing. Staff from CDFG will extract the CWTs from the salmon heads, read and verify the CWTs, and enter the CWT recovery data into an electronic database. The CDFG will use catch/sample data from the ocean fisheries to create electronic catch/sample database files that meet RMIS standards. The CDFG will validate both the recovery and associated catch/sample files and upload the data to the RMIS.

2. Contribution of Chinook Salmon from the Feather River to Inland Escapement, 2007 to 2009

   Objectives: Determine (a) the contribution (number of fish and expansion factors) of Chinook salmon stocks from the Feather River to the Central Valley (CV) natural escapement and hatchery returns, and (b) provide data to CDWR to help with the evaluation of the straying rates of salmon from the Feather River Hatchery.

   Procedures: Staff from CDFG will transport the heads of marked salmon that are collected at the Feather River, Nimbus, and Mokelumne River hatcheries and by various escapement monitoring programs throughout the Central Valley to the CDFG CWT laboratory for processing. Staff from CDFG will extract the CWTs from the salmon heads, read and verify the CWTs, and enter the CWT recovery data into an electronic database. The CDFG will use catch/sample data from the escapement monitoring programs to create electronic catch/sample database files that meet RMIS standards. In addition, CDFG will collect the recovery and catch sample databases from various CV escapement monitoring programs that process the salmon heads they collect in their monitoring programs. The CDFG will validate both the final CV recovery and associated catch/sample files and upload the data to the RMIS.

3. Contribution of Chinook Salmon from the Feather River to Inland Escapement, 1995 to 1999

   Objectives: Determine (a) the contribution (number of fish and expansion factors) of Chinook salmon stocks from the Feather River to the CV Chinook salmon natural escapement and hatchery returns from 1995 through 1999, and (b) provide the data to CDWR to help with the evaluation of straying rates of salmon from the Feather River during that time period.

Procedures: The CDFG will verify the CWT recovery data from CV hatcheries, escapement monitoring, and inland sport harvest monitoring programs for the years 1995 through 1999. The CDFG will verify the 1995 through 1999 CV salmon escapement and inland sport harvest estimates and determine the appropriate catch sample rates for these monitoring programs. Then the CDFG will create and validate the final recovery and associated catch/sample databases for the CV that meet RMIS standards and upload the databases to the RMIS.

Applicable BMPs. Because this project component involves the processing of marked salmon that have already been caught, and compilation of data from these fish, no take will result specifically from this project, and no BMPs are needed.

Deer Creek Flow Enhancement Program

Project Location. The Deer Creek Flow Enhancement Program focuses on the reach of Deer Creek from the existing Deer Creek Irrigation District Dam at the north end of Reed Orchard Road, northeast of Vina in Tehama County, downstream to the confluence with the Sacramento River.

Project Components. The Deer Creek Flow Enhancement Program is a water exchange project intended to provide salmonid passage flows for adult spawners and out-migrant young. The water exchange project on Deer Creek provides for new wells that enable irrigators to switch from stream flow to groundwater, thus leaving water in the creeks during critical spring and fall migration periods and allowing fish to reach areas upstream of the Stanford Vina Diversion Dam in Deer Creek. Central Valley spring-run Chinook salmon are the primary benefactors of this project, with secondary benefits to California Central Valley steelhead and Central Valley fall-run Chinook salmon through improved migration and rearing conditions. The project would improve access by salmonids to and from approximately 25 miles of Deer Creek upstream from the dam. A pilot pumping project for the Deer Creek project using one of the three wells proposed for the project was tested in summer 2003 and 2004.

The CDWR, CDFG, and Deer Creek Irrigation District (DCID) reached a long-term agreement to bypass Deer Creek surface water, which would otherwise have been diverted for agricultural use, and allow it to remain in-stream for fish migration flows in exchange for developing and supplying groundwater in an amount equal to the bypassed flows. The Deer Creek Flow Enhancement Program is designed to fulfill the water needs of local agricultural and domestic water users while achieving the fisheries flow objectives in Deer Creek and the groundwater protection requirements set forth by the Tehama County AB 3030 Groundwater Management Plan. The main components of the program include development of supplemental water supply, implementation of agricultural water use efficiency improvements, and the incorporation of groundwater monitoring and fish passage assessment monitoring.

As part of the 2008 Amendment, the CDWR will fund installation of well infrastructure and program-related management, operations, maintenance, monitoring, and permitting. CDWR funding of the program-related groundwater monitoring, surface water monitoring, and fishery assessment will be provided to the cooperating Resource Agencies.

CDWR, CDFG and DCID, recognize that the exact amount of flow necessary to provide for immigrating of adult salmon and California Central Valley steelhead and emigrating juvenile salmon and California Central Valley steelhead in Deer Creek is unknown but also dependent upon annual climatic conditions, water temperature, agricultural diversions, channel morphology, etc. However, a preliminary adult upstream fish transportation flow objective of 50 cubic feet per second (cfs) was developed for the proposed Program based on an examination of comparable east-side streams in the Northern Sacramento Valley. A preliminary estimate of flow to move downstream migrating juvenile salmon and California Central Valley steelhead is defined as a contiguous flow from the lowermost diversion to the Sacramento River.

In accordance with the initial cost planning and permitting estimates, the proposed Program will operate from April 1 through June 30 and October 15 through November 15 when the Deer Creek flow, as measured below the Stanford Vina Diversion Dam, is equal to or less than 50 cfs, or upon mutual consent of DCID, CDFG, and CDWR. Program operations carried out pursuant to long-term agreement will change from year to year, but will be within the projected range of initial planning and permitting estimates. Program operations will be implemented in flow capacity intervals which are practical for monitoring and approximately equal to the increased capacity associated with individual Program Well capacity and/or capacity intervals associated with water savings due to application of Agricultural Water Use Efficiency (AgWUE) measures. As such, Base Flow contribution by DCID may result in Deer Creek flow greater than 50 cfs, as measured below the Stanford Vina Diversion Dam.

An adaptive management methodology linked to a comprehensive Deer Creek Annual Monitoring Program (DCAMP) will be incorporated into the proposed Program in order to operate the proposed Program effectively and adequately evaluate its potential benefits and impacts. The DCAMP will include baseline surface water monitoring, (both instream and in-district), temperature monitoring, identification of critical channel morphology impediments, groundwater monitoring, and fisheries monitoring for the proposed Program. The DCAMP will be implemented regardless of whether DCID water is bypassed or not to the extent necessary to provide the proposed Program with baseline data needs for assessment of fish movement timing, documentation of annual surface water diversions, and fulfillment of the requirements set forth by the Tehama County Groundwater Extraction and Off-Parcel Use Permit.

The proposed Program will be implemented in two phases. Phase one will fund installation and operation of up to two additional new agricultural water supply wells, and/or the retrofitting and leasing of up to two existing agricultural wells to create a capacity of 10 cfs of groundwater to be used in exchange for surface water bypassed by DCID. Phase one will also include Program-related operations, maintenance, permitting, and monitoring, as well as annual baseline monitoring associated with DCAMP. Phase two will be initiated after completion of the work being funded under Section A of DCID's 2004 Ag WUE Grant. In Phase two, the Parties will determine what amount of additional transportation flow can be made available to the Program through implementation of the agricultural water use efficiency measures and water management

improvements described in DCID's 2004 AgWUE Grant application. Upon completion of both Phase One and Phase Two, DCID may have the additional capacity to provide approximately 15 to 18 cfs of instream transportation flow while meeting agricultural water demand requirements in the District.

Implementing flow augmentation to Deer Creek, without adverse effects to local water users, will require a multi-component program, with operational flexibility based on monitoring and adaptive management techniques. Supplemental water supply can be developed through groundwater substitution pumping. In order to effectively operate and adequately evaluate the potential benefits or impacts associated with the Deer Creek Flow Enhancement Program, the operations will incorporate adaptive management methods linked to a comprehensive monitoring program. It is anticipated that the annual monitoring program will include surface water monitoring, groundwater monitoring, and fisheries assessment/monitoring.

There is considerable scientific uncertainty regarding the amount and duration of instream flow that is required to successfully transport fish, and to what extent Deer Creek Flow Enhancement Program will assist in the restoration of anadromous populations in Deer Creek. In an effort to best accommodate the fish transportation and agricultural diversions requirements, operation of the Deer Creek Program will be tied to habitat monitoring and fish surveys downstream of the Stanford Vina Dam. This will require real-time monitoring of adult fish passage over a number of water year types and changing channel conditions. At a minimum, it will be necessary to assess fish migration after the onset of spring irrigation in order to define the presence and relative abundance of adult spring-run salmon during late-May and June. Monitoring for Central Valley fall-run adult salmon from October 15 to the first precipitation run-off event may also occur. Since adult salmon immigration occurs concurrently with juvenile salmon emigration and since adult fish require more flow for passage than juvenile salmon, late spring and early fall adult salmon bypass flows will be beneficial for emigrating juveniles. A combination of underwater observation and juvenile outmigrants traps can be used to determine the presence of fish outmigrants, although water temperatures in June and October can be lethal for trapped salmonids. During these periods, the blockage or impediments to migration will be alleviated in part by DCID bypassing surface water which otherwise would be diverted for irrigation purposes.

The groundwater substitute pumping aspects of the program, and the requirements set forth in the Tehama County Groundwater Extraction Permit, will require a fairly rigorous groundwater monitoring program that is tied to the overall management of the Deer Creek Flow Enhancement Program. It is anticipated that the groundwater monitoring and management plan used for the 2003 and 2004 DCID Pilot well operation would be modified as needed to accommodate full implementation of the Program.

Applicable BMPs. The following BMPs will be implemented (see *Best Management Practices* below):

- General
- Aquatic and Wetland Species/Water Quality

- Vernal Pool Plants (if access to wells or monitoring areas will occur near vernal pool habitat)
- Vernal Pool Branchiopods (if access to wells or monitoring areas will occur near vernal pool habitat)
- Valley Elderberry Longhorn Beetle (if access to wells or monitoring areas will occur near habitat)
- Giant Garter Snake

Mill Creek Water Exchange Program

Project Location. The Mill Creek Water Exchange Program focuses on the lower reach of Mill Creek, roughly from the east side of the Sacramento Valley floor downstream to its confluence with the Sacramento River, north of Los Molinos in Tehama County. This project's action area also includes the locations of wells on TNC's Dye Creek Preserve.

Project Components. The Mill Creek Water Exchange Program is designed to provide salmonid passage flows for adult spawners and out-migrant young. The water exchange project on Mill Creek provided for new wells that enable irrigators to switch from stream flow to groundwater, thus leaving water in the creeks during critical spring and fall migration periods and allowing salmonids to access up to 35 miles of spawning, rearing, and migration habitat. Central Valley spring-run Chinook salmon are the primary benefactors of this project, with secondary benefits to California Central Valley steelhead and Central Valley fall-run Chinook salmon through improved migration and rearing conditions. The Mill Creek project is completely implemented and has operated since 1990. Ongoing necessary operations and maintenance for this project continue to be funded by CDWR.

Mill Creek, a tributary of the Upper Sacramento River, is one of only a few waterways in the Central Valley that continue to support native populations of wild spring-run salmon. Upper reaches of the creek provide 35 miles of ideal holding and spawning habitat -- undercut banks, deep pools, and cold springs. In recent years the spring-run population in Mill Creek has dwindled to a few hundred adults in contrast to an average of 2000 in the 1950s. A key factor that limits the population in some years is the lack of sufficient water for passage to upstream habitat. In dry years, water right holders may divert nearly the entire flow of lower Mill Creek during the critical migration period of May to early June. As a result, upstream migration of adult spring-run Chinook and downstream migration of juvenile salmon and California Central Valley steelhead is impeded or entirely blocked. If low flows persist in the creek, water temperatures quickly exceed the tolerance range for these species. Supplemental flows will help restore the population of wild spring-run Chinook by allowing migrating adults to reach their spawning habitat and by providing transportation flows for juveniles en route to the Sacramento River.

The first phase successfully provided transportation flows during migration periods of 1990 through 1992. The number of adults migrating to holding and spawning areas was encouraging and established that the supplemental flows are essential to the restoration of the spring-run salmon population in Mill Creek. Although Phase I was demonstrably successful in increasing

the number of adult fish that passed upstream, water exchanges under Phase I are constrained by the instantaneous capacity of the State's wells (9 cfs).

Under Phase II of the project, the CDWR paid Jones Prune Orchards, Inc. (Buck Jones) for (1) the operation and maintenance of a ground water well which has been installed with CDFG funds, and (2) the operation and maintenance and about 20 percent of the installation cost of a second well. In exchange for the use of the two wells, Buck Jones will stop diverting from Mill Creek and allow CDFG to use the Jones' water right for a minimum of 15 years. CDFG allows the Los Molinos Mutual Water Company to use the water right during the summer irrigation season in exchange for reducing its diversions from Mill Creek in the fall when additional stream flow is needed for salmon migration and spawning. This project increases CDFG's on-demand Mill Creek flow by about 14 cubic feet per second, bringing the total flow it controls up to about 25 cubic feet per second. In 2007, Delta Fish Agreement staff extended the water right lease agreement for two years to allow for the water right purchase to be negotiated between The Nature Conservancy (TNC) and Buck Jones, over the next two years.

Applicable BMPs. The following BMPs will be implemented (see *Best Management Practices* below):

- General
- Aquatic and Wetland Species/Water Quality
- Vernal Pool Plants (if access to wells or monitoring areas will occur near vernal pool habitat)
- Vernal Pool Branchiopods (if access to wells or monitoring areas will occur near vernal pool habitat)
- Valley Elderberry Longhorn Beetle (if access to wells or monitoring areas will occur near habitat)
- Giant Garter Snake

Butte Creek Fish Passage Projects

Project Location. The Parrott Phelan and Durham Mutual Dams, and their associated fish ladders and screens, are located along Butte Creek southeast of Chico in Butte County, California.

Project Components. This project includes the operations and maintenance for two existing fish ladders and screens that provide improved upstream salmonid passage for adult spawners on Butte Creek. The Parrott Phelan project was completed in 1995 and the Durham Mutual project was completed in 1999. These projects improve passage for adult spring-run Chinook salmon on Butte Creek, with secondary benefits to California Central Valley steelhead and Central Valley fall-run Chinook salmon. The Butte Creek spring-run salmon contribution makes up better than half of the entire spring-run Chinook population. These fish ladders have improved salmon survival by allowing adult spawners to pass upstream during low water periods, through the

quick passage of salmon progeny downstream, and by decreased injury of adults during all water years. These passage projects were implemented with Delta Fish Agreement cost-share funding that helped to the fund construction of these fish ladders.

CDWR will fund the operations and maintenance of these two facilities to ensure that they are functioning appropriately. Activities include repair, maintenance, and weekly site visits to ensure adequate fish passage and/or the proper operation of the fish screen.

Applicable BMPs. The following BMPs will be implemented (see *Best Management Practices* below):

- General
- Aquatic and Wetland Species/Water Quality
- Valley Elderberry Longhorn Beetle (if access, monitoring, maintenance, or repair will occur near habitat)
- Giant Garter Snake

Spring-run Warden Overtime

Project Location. The Spring-run Warden Overtime project involves the work of CDFG wardens on Mill, Deer, Antelope, Butte, Big Chico, Cottonwood and Battle Creeks, as well as Sacramento, Yuba, and Feather Rivers.

Project Components. Enhanced law enforcement efforts from San Francisco Bay upstream into the Sacramento and San Joaquin rivers and their tributaries benefit Central Valley fall-run, winter-run, and spring-run Chinook salmon, and many other species. In addition to enhanced law enforcement efforts, focused enforcement efforts from the Bay upstream into the Sacramento River specifically benefit winter-run and spring-run Chinook salmon.

The Spring-run Salmon Increased Protection Project provides overtime wages for CDFG wardens to focus on spring-run Chinook salmon protection, reducing illegal take and illegal water diversions on upper Sacramento River tributaries and adult holding areas where fish are particularly vulnerable to poaching. The project covers Mill, Deer, Antelope, Butte, Big Chico, Cottonwood, and Battle Creeks, as well as Sacramento, Yuba, and Feather Rivers and has been in effect since 1996.

The four major objectives for protection of spring-run salmon are:

1. Increased patrol time during adult migrations of spring-run salmon. Spring-run salmon are particularly vulnerable to poaching during upstream migrations. It is important to insure the survival of all potential adult spawners for without adequate numbers of adults to perpetuate the species all other recovery efforts will fail.

2. Monitoring of habitat and water quality during migration of spring-run salmon. The timing of migration and the stream corridors used for upstream and downstream passage make spring-run salmon vulnerable to a wide range of potentially lethal or adverse conditions which could put both adults and juveniles in jeopardy. Wardens are well suited to provide protection for the spring-run salmon as they make their migration by adding patrol time to watch for adverse conditions which could threaten stream migration corridors. The intensified patrol effort provided to prevent pollution or for monitoring of diversions or fish passage facilities will protect both adults and smolts from catastrophic losses caused by poor environmental conditions.

3. Increased patrol time during summer hold-over and spawning periods for adult salmon. Central Valley spring-run salmon are very vulnerable to poachers during summer hold-over periods when they are concentrated in summer hold-over pools or when they exit the pools and become tempting targets in shallow water when they are spawning. Extra patrol is necessary to prevent violations and extra effort is needed for the apprehension of serious poachers.

4. Monitoring of habitat and water quality during summer hold-over periods and spawning season. Central Valley spring-run salmon are subjected to a wider range of potential adverse impacts in their habitat than other races of salmon. Because they arrive in the spring to streams which they hold over until early fall they are subject to pollution or habitat degradation for a considerable length of time. The habitat which supports them must be protected from adverse conditions arising from pollution or other degrading conditions.
   Periodic checks of environmental conditions such as sediment deposition in spawning gravels, thermal degradation, or other factors that affect salmon during hold-over or spawning season are essential to prevent losses.

Applicable BMPs. Because this project component involves enhanced law enforcement concerning federally listed species, no take will result specifically from this project, and no BMPs are needed.

Other Potential Conservation Actions

In addition to the early implementation actions and the ongoing actions described above, other conservation actions will be implemented pursuant to the 2008 Amendment. Some of these potential conservation actions have been identified, at least conceptually, by programs such as the Yolo Bypass Interagency Work Group's "5 Point Proposal." Other conservation actions that have not yet been identified may also be undertaken. The following sections describe conceptually some of the potential conservation actions that may be undertaken.

Yolo Bypass Conservation Actions

Project Location. These projects may be undertaken anywhere in the Yolo Bypass, a 58,000-acre area west of the Sacramento River and west of Sacramento. The Yolo Bypass extends from Cache Creek and the Fremont Weir at its northern/upstream end to the Prospect Slough/Cache Slough area at its southern/downstream end.

Project Components. The CALFED ERP Implementing Agency Managers and CDWR, in consultation with the Yolo Bypass Interagency Working Group, have set forth recommendations for aquatic restoration activities within the Yolo Bypass with the understanding that monitoring would be critical to inform future planning (CDFG et al. 2007). Five potential restoration opportunities were identified that will improve conditions for native fish species and enhance populations and recovery efforts, while at the same time maintaining and/or improving existing land conditions for management. This 5-step sequential restoration plan includes:

1. Lower Putah Creek Re-Alignment
2. Lisbon Weir Improvements
3. Additional Multi-species Floodplain Habitat Development
4. Tule Canal Conductivity
5. Fremont Weir Fish Passage

The first step would be to evaluate and develop a plan for the realignment and restoration of lower Putah Creek. This realignment has the potential of creating 130 to 300 acres of shallow water habitat that would help to improve salmonid immigration and emigration to and from Putah Creek, and increase and enhance aquatic and riparian habitat for other native species. Much of this is already underway through the Yolo Basin Wildlife Area Management Plan. Lisbon Weir restoration would include modification and replacement of the weir to provide better fisheries management opportunities in Putah Creek and the Toe Drain, while improving reliability and reducing maintenance. Expansion of existing shallow water multi-species habitat is proposed to take place through excavation of a low shelf along the Toe Drain and creating small-scale set-back levees. Tule Canal connectivity restoration includes areas between Fremont Weir, the Fremont Weir scour ponds, and the Toe Drain to help reduce stranding of adult and juvenile fish. In addition, other barriers (road crossings, agricultural impoundments) will be identified and evaluated to reduce the impact on habitat connectivity, immigration, and emigration of fish species that use the Yolo Bypass. Lastly, evaluating the feasibility and appropriateness of providing fish passage improvements in and along the Fremont Weir should take place.

These actions would provide the following benefits:

1. Increase inundation frequency to yearly or biannual.
2. Improve quality and availability of juvenile salmonid rearing and migration habitat.
3. Improve quality and availability of splittail spawning and rearing habitat.

4. Improve primary production exports to the lower Sacramento River/west Delta.
5. Provide for improved salmon and splittail access to Putah Creek.
6. Improve fish passage at Fremont weir.
7. Improve migratory and resident bird habitats.

These actions would improve existing habitats and values provided by one of the most significant flood control structures through diversity of habitats and enhancements of outdated facilities. They would also increase primary production inputs to the Delta during important spring flooding conditions and provide additional data on operational impacts at a population level of listed salmon and sturgeon.

Applicable BMPs. The following BMPs will be implemented (see *Best Management Practices* below):

- General
- Aquatic and Wetland Species/Water Quality
- Vernal Pool Plants
- Vernal Pool Branchiopods
- Valley Elderberry Longhorn Beetle
- Giant Garter Snake

Sacramento Basin Projects

Project Location. The single potential project that has been identified in this category, the Mill Creek Water Right Opportunities project, is located in the action area for the Mill Creek Water Exchange Program described above. These two projects focus on the lower reach of Mill Creek, roughly from the east side of the Sacramento Valley floor downstream to its confluence with the Sacramento River, north of Los Molinos in Tehama County. These projects' action areas also include the locations of wells on TNC's Dye Creek Preserve.

Project Components. The Mill Creek Water Right Opportunities project involves the purchase by TNC of the Buck Jones-Mill Creek Water Right, which the Delta Fish Agreement continues to lease as part of the current Mill Creek Water Exchange Program. In 2007, Delta Fish Agreement staff extended the water right lease agreement for two years while the water right purchase was being negotiated. Once the water right is secured by TNC for the support of wildlife, the Delta Fish Agreement lease would no longer be necessary. At that time there will be discussions between TNC and CDFG regarding incorporating this water right with others to be included into the Long-term Cooperative Management Plan for Mill Creek. CDWR and CDFG will continue to look for opportunities where the Delta Fish Agreement Program might continue to actively support Mill Creek Water flow activities in the future.

Applicable BMPs. Because this project involves only the purchase of water rights, no BMPs are needed. However, see the BMPs under *Mill Creek Water Exchange Program* above to be implemented if access to wells or monitoring areas will occur near vernal pool habitat.

Projects in the Delta, Suisun Marsh, and Cache Slough Complex

Project Location. These restoration projects would be located in the Delta, Suisun Marsh, and the Cache Slough Complex where existing non-tidal areas possess conditions conducive to the restoration of tidal wetlands or other projects beneficial to the target fish species. The areas where restoration projects would most likely occur are those shown as having suitable elevations for intertidal habitat in Suisun Marsh, the Cache Slough Complex, and the northern Delta (rather than the southern Delta region or the central/"deep" Delta) on a draft figure entitled "Intertidal and Low-Lying Uplands Elevations in the Delta and Suisun" in the 24 April 2008 draft document prepared by the Delta Vision Ecosystem Work Group (EWG) entitled, *EWG Recommendations: Strategic Plan for Restoring the Delta's Ecosystem*.

Project Components. There are a number of areas within the Delta, Suisun Marsh, and the Cache Slough Complex where existing conditions are conducive to the restoration of tidal wetland restoration based on existing land cover and elevation. According to the 24 April 2008 figure from the draft *EWG Recommendations: Strategic Plan for Restoring the Delta's Ecosystem*, most of the areas within the northern Delta that are most suitable for restoration of tidal marsh are at the upper (*i.e.*, western, northern, and eastern) edges of the Delta rather than in the central or "deep" Delta, where land subsidence has reduced the suitability of terrestrial areas for tidal marsh restoration.

The Cache Slough Complex has become an important focus for restoration activities in the north Delta to increase and improve the overall habitat for delta smelt. The Cache Slough Complex includes Liberty Island and Prospect Island, which are the sites of proposed early implementation actions, as well as the Little Holland Tract. It also includes open water, Calhoun Cut, the pumping plant for the North Bay Aqueduct, the Sacramento Deep Water Channel, and Lindsey, Barker, Shag, Cache, Prospect, and Miner Sloughs. Restoration actions would include land acquisition, focused research on species response and natural processes to guide levee, channel, and bathymetric changes to promote appropriate water circulation, improved water quality, food web production, and important habitat for delta smelt.

Examples of potential restoration projects in the Cache Slough Complex that may be implemented under the 2008 Amendment include:

1. Western Cache Slough Complex
2. Little Holland Tract
3. Eastern Egbert Tract

Specific goals for the Cache Slough Complex include:

1. Fund baseline assessments and land acquisition at potential project sites.
2. Revisit and revive projects on Prospect Island and Liberty Island that were considered and developed technically, but lost funding or support prior to implementation.
3. Initiate a planning effort to develop additional tidal marsh in currently leveed areas at tidal elevations.
4. Act to preserve and enhance high-value habitat on Little Holland Tract and tidally active portions of Liberty Island.
5. Protect vegetation and habitat in the freshwater sloughs in the area including Lindsey, Barker, and Cache Sloughs and support restoration of Calhoun Cut.

The Suisun Marsh area also provides a number of restoration opportunities in the form of previously tidal marshes that have since been diked (and, in many cases, drained). The Meins Landing Tidal Marsh Restoration Project is an example of a potential tidal restoration project that could be implemented in the Suisun Marsh area. Restoration actions might include land acquisition and restoration of tidal action to provide habitats to support at-risk aquatic and terrestrial species and to reduce ongoing adverse effects of diked lands management (especially low dissolved oxygen and subsidence).

Applicable BMPs. The following BMPs will be implemented (see *Best Management Practices* below):

- General
- Aquatic and Wetland Species/Water Quality
- Soft Bird's-beak/Suisun Thistle
- Vernal Pool Plants
- Vernal Pool Branchiopods
- Valley Elderberry Longhorn Beetle
- California Tiger Salamander
- California Red-legged Frog
- Giant Garter Snake
- California Clapper Rail
- Western Snowy Plover/California Least Tern
- Salt Marsh Harvest Mouse

Delta Fish Agreement 2008 Amendment-Best Management Practices

Each specific conservation action proposed pursuant to the 2008 Amendment will undergo its own project-specific section 7 consultation, consistent with the current programmatic consultation for the 2008 Amendment conservation program. A project-specific Biological Assessment will be prepared for each specific action. During the preparation of these Biological Assessments, the applicants will undertake the standard practice of researching background information on specific listed species and designated critical habitat present within the action area of that specific project, conducting habitat assessments and surveys as appropriate, and proposing impact avoidance and minimization measures for individual listed species that are, or may be, present. To document that CDWR will take the appropriate steps to avoid and minimize adverse effects on the target species and designated critical habitat, some detail regarding the process by which avoidance and minimization will occur is provided below.

A number of measures will be taken to avoid and minimize adverse effects of 2008 Amendment conservation actions on federally listed or proposed species, and designated critical habitat, that might be present within the action area for a given activity. The species and designated critical habitat for which these measures, or BMPs, will be implemented are described in the *Status of the Species* section below.

Because these conservation actions are designed specifically to benefit winter-run Chinook salmon, spring-run Chinook salmon, delta smelt, and longfin smelt, their long-term effects on these and other fish species, such as the California Central Valley steelhead, Central California Coast steelhead, and green sturgeon, will be overwhelmingly beneficial. Nevertheless, BMPs to reduce short-term adverse effects on these target species (*e.g.*, through adverse effects on water quality) will be implemented. In addition, BMPs will be implemented to avoid and minimize adverse effects on terrestrial and wetland species that may currently inhabit areas where 2008 Amendment conservation actions are proposed.

The BMPs to be implemented for any given action will vary by the species present, and the listed/proposed species in question will vary by geographic location and habitat of the conservation area. As a result, not all BMPs apply to all conservation actions. Therefore, BMPs are grouped by the potential species/resource that they are intended to protect.

<u>General BMPs:</u>

- For any given activity, a representative shall be appointed who will be the contact source for any employee or contractor who might encounter a listed species. The representative(s) shall be identified during the environmental awareness program. The representative's name and telephone number shall be provided to USFWS and NMFS prior to the initiation of any activities.

Aquatic and Wetland Species/Water Quality:

- Vehicle staging, cleaning, maintenance, refueling, and fuel storage will be located 150 feet or more from any stream, water body, or wetland. If an action cannot meet this 150-foot requirement, additional BMPs may be required and will be described for each action.
- A hazardous spill plan will be developed prior to construction of each action. The plan will describe what actions will be taken in the event of a spill. The plan will also incorporate preventative measures to be implemented, such as the placement of refueling facilities, storage and handling of hazardous materials, etc.
- No more than 4,000 gallons of fuel will be transported within a project site at any one time.
- Contaminants will be stored within bermed containment areas lined with an impermeable membrane and designed to hold 125 percent of total fuel capacity. Containment areas will be located as far from live water as possible within the staging area. Contaminant absorbent materials will be stored within each containment area. Water collected within containment areas will be disposed of according to federal, state, and local regulations.
- Equipment will be refueled only in the staging area. Fuel absorbent mats will be used when refueling equipment.
- All equipment (including personal gear) will be cleaned of soil, seeds, and plant material prior to arriving on site to prevent introduction of undesirable plant species. Equipment and personal gear will be subject to inspection.
- All equipment will be maintained free of petroleum leaks. No equipment will enter live water except for equipment designed specifically for aquatic or amphibious use.
- Absorbent materials will be maintained at each worksite in sufficient quantity to effectively immobilize the volume of petroleum-based fluids contained in the largest tank present at the site. Acceptable absorbent materials are those that are manufactured specifically for the containment and clean up of hazardous materials. Sands or soil are not approved absorbent materials.
- In the event of a contaminant spill, work at the site will immediately cease while the absorbent materials are deployed to contain, control, and mitigate the spill. The contractor will immediately prevent further contamination, notify appropriate authorities, and mitigate damage as appropriate.
- Site work will resume when the spill kit is resupplied with a sufficient quantity of material capable of effectively immobilizing the volume of petroleum-based fluids contained in the largest tank present at the site.
- Containers for storage, transportation, and disposal of contaminated absorbent materials will be provided on the project site. Petroleum products and contaminated soil will be disposed of according to federal, state, and local regulations.
- Any machinery that will be left on temporary platforms or parked within 150 feet of a water body including portable water pumps will be placed in a full containment cell.

- All vehicles operated within 150 feet of any water body will be inspected daily for leaks and, if necessary, repaired before leaving the staging area. Inspections will be documented in a record that is available for review on request.
- Machinery and implements that are used during the project will be in good repair, free of excessive leaks, and steam cleaned off-site prior to entering the work area. Fluid leaks will either be repaired or contained within a suitable waste collection device (*e.g.*, drip pads, drip pans). When changing hydraulic lines, care will be taken to keep hydraulic fluid from entering a water body or soils.
- There will be no debris introduction into the channels, wetlands, or environmentally sensitive areas from project work. Project sites will be maintained trash-free and food refuse will be contained in secure bins and removed daily.
- All disturbed areas will be stabilized within 12 hours of any break in work unless construction will resume work within 7 days. Earthwork will be completed as quickly as possible and site restoration will occur immediately following use.
- A supply of emergency erosion control materials will be on hand at the project site.
- Vehicles driving on levees to access tidal sloughs or channels for construction or monitoring activities will travel at speeds no greater than 10 mph to minimize noise and dust disturbance.
- Silt fences will be erected adjacent to areas of ground disturbance to define and isolate work areas from sensitive habitats.
- In all activities involving the use of heavy equipment, the project will use berms and/or silt fences to contain the placement of materials, implementing remedial measures, and minimizing the area impacted.
- Treated wood will not be used in structures that are in contact with water on a daily basis.
- All clean fill material proposed for upland and wetland placement will meet the qualifications set forth in the Regional Water Quality Control Board's (RWQCB) waste discharge requirements (Tentative Order), approved with respect to chemical and biological suitability for uplands and wetlands by the Dredged Material Management Office (DMMO). If the above-mentioned thresholds are not attained and the material is approved for use by the RWQCB, consultation will be reinitiated to analyze the potential effects of the material to listed species.
- Levee breaching will not occur when susceptible life stages of target fish species are likely to be present in the project area; in general this period occurs from December through July. Outmigration of juvenile salmonids occurs primarily between December and June, delta smelt spawning adults and larval stages are likely to occur primarily between November and June, longfin smelt adults and larval stages are likely to occur between November and April, and larval/post-larval green sturgeon are likely to occur between May and October but peak in June and July.
- Prior to construction, CDWR will develop a remediation plan that contains various strategies to deal with potential adverse environmental conditions, such as low dissolved

oxygen or exotic aquatic plant invasions (*e.g.*, *Egeria* or water hyacinth), that may result from the proposed conservation projects and reduce the benefits that these projects will provide. This plan would also address the potential effects of methylmercury as appropriate.

Soft Bird's-beak/Suisun Thistle:

- A biologist will conduct a search of California Natural Diversity Database (CNDDB) records using the most recent updates to the database, a search of California Native Plant Society (CNPS) records and other information (*e.g.*, from the USFWS and Consortia of California Herbaria), and a review of any previous studies conducted and documents prepared for the specific project in question or nearby projects, to determine if either species has been recorded on or within 5 miles of the project site.
- A qualified botanist will conduct a survey of the project site and immediately adjacent areas to determine whether any salt marsh habitat that may support these species is present on the site, or in adjacent areas that could be directly or indirectly affected by the project (*e.g.*, by alteration of hydrology).
- If potential habitat for these species is present on the project site, or in adjacent areas that could be directly or indirectly affected by the project, then either:
    - Protocol-level surveys will be conducted by a qualified botanist during the appropriate season for identifying these species to determine whether either species is present; or
    - Potential presence of these species will be assumed and the site will not be used for restoration; or
    - Potential presence of these species will be assumed and the project will be designed so that areas providing habitat for the species, as well as areas contributing to the hydrology of these habitat areas, will not be adversely affected by restoration.
- Restoration activities will not be performed in habitat for these species, or in areas that will result in adverse effects to habitat, unless a protocol-level survey has been conducted to determine whether and how many soft bird's-beak and/or Suisun thistle individuals occur on the site. If such a survey detects either species within the project site, or in adjacent areas that could be directly or indirectly affected by the project, then either:
    - The site will not be used for restoration; or
    - The project will be designed so that areas providing habitat for the species, as well as areas contributing to the hydrology of these habitat areas, will not be adversely affected by restoration; or
    - If avoidance of impacts to these species is not practicable, or if impacting small numbers of individuals will allow for significant habitat enhancement through tidal restoration, then consultation with the USFWS during the project-specific section 7 consultation will identify whether take of the species is permissible

(*e.g.*, depending on the number of individuals or extent of suitable/occupied habitat to be impacted) and whether compensatory mitigation via habitat creation and preservation, and establishment of new populations in the preserved habitat, is appropriate. If such take is permissible and compensatory mitigation is appropriate, a compensatory mitigation plan, which will include transplantation of and/or collection and planting of seeds from affected individuals, will be developed by a qualified restoration ecologist, in consultation with the USFWS.

- If either species is detected within or adjacent to the project site, or if presence has been assumed on or adjacent to the site:
    - A qualified biologist will identify measures specific to the project site in question that will avoid or minimize impacts to the species in question. Such measures might include preconstruction surveys for the species immediately prior to initiation of restoration activities; maintenance of disturbance-free buffers around occupied/potential habitat; off-site equipment, tire, and undercarriage washing to prevent weed seed introduction into occupied/potential habitat; use of Environmentally Sensitive Area (ESA) fencing to prevent inadvertent impacts to occupied/potential habitat; use of silt fencing to prevent inadvertent siltation of occupied/potential habitat; and dust control to prevent impacts to wetlands and associated plants from blowing dust.
    - All activity within suitable vegetated marsh habitat will be minimized.
    - For any activities that involve walking through suitable marsh habitat repeatedly (*e.g.*, monitoring), different paths through the marsh will be taken during consecutive visits to minimize impacts to habitat in any given area. A route will be determined which will minimize the amount of foot traffic in the marsh and maximize the use of existing roads and trails.
    - Clearing will be confined to the minimal area necessary to facilitate construction activities.
    - Construction personnel will receive USFWS-approved worker environmental awareness training. Under this program, workers shall be informed about the presence of listed species and habitats associated with the species and that unlawful take of the species or destruction of its habitat is a violation of the FESA. Prior to construction activities, a qualified biologist approved by USFWS shall instruct all construction personnel about: (1) the description and status of the species; (2) the importance of their associated habitats; and (3) a list of measures being taken to reduce impacts to these species during project construction and implementation. A fact sheet conveying this information shall be prepared for distribution to the construction crew and anyone else who enters the project site. This information will be kept on-site during all construction activities.

Vernal Pool Plants (Hoover's Spurge, Hairy Orcutt Grass, Slender Orcutt Grass, Greene's Tuctoria, Colusa Grass, Solano Grass, and Contra Costa Goldfields):

- A biologist will conduct a search of CNDDB records using the most recent updates to the database, a search of CNPS records and other information (*e.g.*, from the USFWS and Consortia of California Herbaria), and a review of any previous studies conducted and documents prepared for the specific project in question or nearby projects, to determine if any of these species has been recorded on or within 5 miles of the project site.
- A qualified botanist will conduct a survey of the project site and immediately adjacent areas to determine whether vernal pools or other seasonal wetlands that may support these species are present on the site, or in adjacent areas that could be directly or indirectly affected by the project (*e.g.*, by alteration of hydrology in vernal pools or swales).
- If potential habitat for one or more of these species is present on the project site, or in adjacent areas that could be directly or indirectly affected by the project, then either:
    - Protocol-level surveys will be conducted by a qualified botanist during the appropriate season for identifying these species to determine whether these species are present; or
    - Potential presence of the species will be assumed and the site will not be used for restoration; or
    - Potential presence of the species will be assumed and the project will be designed so that areas providing habitat for these species, as well as areas contributing to the hydrology of these habitat areas, will not be adversely affected by restoration.
- Restoration activities will not be performed in habitat for these species, or in areas that will result in adverse effects on habitat, unless a protocol-level survey has been conducted to determine whether and how many individuals of these species occur on the site. If such a survey detects the species within the project site, or in adjacent areas that could be directly or indirectly affected by the project, then either:
    - The site will not be used for restoration; or
    - The project will be designed so that areas providing habitat for these species, as well as areas contributing to the hydrology of these habitat areas, will not be adversely affected during restoration; or
    - If avoidance of impacts to one or more of these species is not practicable, or if impacting small numbers of individuals will allow for significant habitat enhancement through the proposed restoration, then consultation with the USFWS during the project-specific section 7 consultation will identify whether take of the species is permissible (*e.g.*, depending on the number of individuals or extent of suitable/occupied habitat to be impacted) and whether compensatory mitigation via habitat creation and preservation, and establishment of new populations in the preserved habitat, is appropriate. If such take is permissible and compensatory mitigation is appropriate, a compensatory mitigation plan, which will include transplantation of and/or collection and planting of seeds from affected

individuals, will be developed by a qualified restoration ecologist, in consultation with the USFWS.

- If one or more of these species is detected within or adjacent to the project site, or if presence has been assumed on or adjacent to the site:
    - Clearing will be confined to the minimal area necessary to facilitate construction activities.
    - A qualified biologist will identify measures specific to the project site in question that will avoid or minimize impacts to the species in question. Such measures might include preconstruction surveys for the species immediately prior to initiation of restoration activities; maintenance of disturbance-free buffers around occupied/potential habitat; off-site equipment, tire, and undercarriage washing to prevent weed seed introduction into occupied/potential habitat; use of ESA fencing to prevent inadvertent impacts to occupied/potential habitat; use of silt fencing to prevent inadvertent siltation of occupied/potential habitat; and dust control to prevent impacts to vernal pools and associated plants from blowing dust.
    - Construction personnel will receive USFWS-approved worker environmental awareness training. Under this program, workers shall be informed about the presence of listed species and habitats associated with the species and that unlawful take of the species or destruction of its habitat is a violation of the FESA. Prior to construction activities, a qualified biologist approved by USFWS shall instruct all construction personnel about: (1) the description and status of the species; (2) the importance of their associated habitats; and (3) a list of measures being taken to reduce impacts to these species during project construction and implementation. A fact sheet conveying this information shall be prepared for distribution to the construction crew and anyone else who enters the project site. This information will be kept on-site during all construction activities.

<u>Vernal Pool Branchiopods (Conservancy Fairy Shrimp, Vernal Pool Fairy Shrimp, and Vernal Pool Tadpole Shrimp):</u>

- A biologist will conduct a search of CNDDB records using the most recent updates to the database, and review other information (*e.g.*, from the USFWS or any previous studies conducted and documents prepared for the specific project in question or nearby projects), to determine if any of these species has been recorded on or within 5 miles of the project site.
- A qualified biologist will conduct a survey of the project site and immediately adjacent areas to determine whether vernal pools or other temporary seasonal wetlands that may support these species are present on the site, or in adjacent areas that could be directly or indirectly affected by the project (*e.g.*, by alteration of hydrology in vernal pools or swales).

- If potential habitat for one or more of these species is present on the project site, or in adjacent areas that could be directly or indirectly affected by the project, then either:
    - Protocol-level surveys will be conducted by a qualified biologist to determine whether these species are present; or
    - Potential presence of the species will be assumed and the site will not be used for restoration; or
    - Potential presence of the species will be assumed and the project will be designed so that areas providing habitat for these species, as well as areas contributing to the hydrology of these habitat areas, will not be adversely affected by restoration.
- Restoration activities will not be performed in habitat for these species, or in areas that will result in adverse effects on habitat, unless a protocol-level survey has been conducted to determine whether these species occur on the site. If such a survey detects one or more of these species within the project site, or in adjacent areas that could be directly or indirectly affected by the project, then either:
    - The site will not be used for restoration; or
    - The project will be designed so that areas providing habitat for these species, as well as areas contributing to the hydrology of these habitat areas, will not be adversely affected by restoration; or
    - If avoidance of impacts to one or more of these species is not practicable, then consultation with the USFWS during the project-specific section 7 consultation will identify whether take of the species is permissible (*e.g.*, depending on the extent of suitable/occupied habitat to be impacted) and whether compensatory mitigation via habitat creation and preservation, and establishment of new populations in the preserved habitat, is appropriate. If such take is permissible and compensatory mitigation is appropriate, a compensatory mitigation plan will be developed by a qualified restoration ecologist, in consultation with the USFWS.
- If one or more of these species is detected within or adjacent to the project site, or if presence has been assumed on or adjacent to the site:
    - A qualified biologist will identify measures specific to the project site in question that will avoid or minimize impacts to the species in question. Such measures might include maintenance of disturbance-free buffers around occupied/potential habitat, and around the watersheds of the vernal pools in which these species occur; use of ESA fencing to prevent inadvertent impacts to occupied/potential habitat; use of silt fencing to prevent inadvertent siltation of occupied/potential habitat; and dust control to prevent impacts to vernal pools and associated species from blowing dust.
    - Construction personnel will receive USFWS-approved worker environmental awareness training. Under this program, workers shall be informed about the presence of listed species and habitats associated with the species and that unlawful take of the species or destruction of its habitat is a violation of the

Federal Endangered Species Act. Prior to construction activities, a qualified biologist approved by USFWS shall instruct all construction personnel about: (1) the description and status of the species; (2) the importance of their associated habitats; and (3) a list of measures being taken to reduce impacts to these species during project construction and implementation. A fact sheet conveying this information shall be prepared for distribution to the construction crew and anyone else who enters the project site. This information will be kept on-site during all construction activities.

Valley Elderberry Longhorn Beetle:

- A biologist will conduct a search of CNDDB records using the most recent updates to the database, and review other information (*e.g.*, from the USFWS or any previous studies conducted and documents prepared for the specific project in question or nearby projects), to determine if this species has been recorded on or within 5 miles of the project site.
- A qualified biologist will conduct a survey of the project site and immediately adjacent areas to determine whether elderberry shrubs that may support this species are present on the site, or in adjacent areas that could be directly or indirectly affected by the project.
- If potential habitat for this species is present on the project site, or in adjacent areas that could be directly or indirectly affected by the project, then either:
    - Protocol-level surveys will be conducted by a qualified biologist to determine whether this species is present; or
    - Potential presence of the species will be assumed and the site will not be used for restoration; or
    - Potential presence of the species will be assumed and the project will be designed so that areas providing habitat for this species will not be adversely affected by restoration.
- Restoration activities will not be performed in habitat, or in areas that will result in adverse effects on habitat, unless a protocol-level survey has been conducted to determine whether this species occurs on the site. If such a survey detects the species within the project site, or in adjacent areas that could be directly or indirectly affected by the project, then either:
    - The site will not be used for restoration; or
    - The project will be designed so that areas providing habitat for this species will not be adversely affected by restoration; or
    - If avoidance of impacts to this species is not practicable, then consultation with the USFWS during the project-specific section 7 consultation will identify whether take of the species is permissible (*e.g.*, depending on the extent of suitable/occupied habitat to be impacted) and whether compensatory mitigation via habitat creation and preservation, and establishment of new populations in the

preserved habitat, is appropriate. If such take is permissible and compensatory mitigation is appropriate, a compensatory mitigation plan will be developed by a qualified restoration ecologist, in consultation with the USFWS.

- If this species is detected within or adjacent to the project site, or if presence has been assumed on or adjacent to the site:
    - Clearing will be confined to the minimal area necessary to facilitate construction activities.
    - A qualified biologist will identify measures specific to the project site in question that will avoid or minimize impacts to the species in question. Such measures might include maintenance of disturbance-free buffers around occupied/potential habitat; use of ESA fencing to prevent inadvertent impacts to elderberry shrubs; and dust control to prevent impacts to vernal pools and associated species from blowing dust.
    - Construction personnel will receive Service-approved worker environmental awareness training. Under this program, workers shall be informed about the presence of listed species and habitats associated with the species and that unlawful take of the species or destruction of its habitat is a violation of the FESA. Prior to construction activities, a qualified biologist approved by USFWS shall instruct all construction personnel about: (1) the description and status of the species; (2) the importance of their associated habitats; and (3) a list of measures being taken to reduce impacts to these species during project construction and implementation. A fact sheet conveying this information shall be prepared for distribution to the construction crew and anyone else who enters the project site. This information will be kept on-site during all construction activities.

<u>California Tiger Salamander:</u>

- A biologist will conduct a search of CNDDB records using the most recent updates to the database, and review other information (*e.g.*, from the USFWS or any previous studies conducted and documents prepared for the specific project in question or nearby projects), to determine if this species has been recorded on or within 5 miles of the project site.
- A qualified biologist will conduct a survey of the project site and, either on the ground or using aerial photos and topographic maps, of areas within 1.3 miles of the project site to determine whether pools or ponds that may support breeding California tiger salamanders are present. The biologist will also conduct a survey of the project site to determine whether habitats, both aquatic and upland, are suitable for California tiger salamanders.
- If known or potential aquatic breeding habitat for this species is present on the site, or if known or potential aquatic breeding habitat is present within 1.3 miles of the project site and the project site provides suitable upland habitat for the species, then <u>either</u>:
    - Protocol-level surveys will be conducted by a qualified biologist to determine whether this species is present; <u>or</u>

  - Potential presence of the species will be assumed and the site will not be used for restoration; or
  - Potential presence of the species will be assumed and the project will be designed so that areas providing habitat for this species will not be adversely affected by restoration.

- If presence is assumed or California tiger salamanders are detected on the site, and avoidance of habitat is not practicable, then consultation with the USFWS during the project-specific section 7 consultation will identify whether take of the species is permissible (*e.g.*, depending on the extent of suitable/occupied habitat to be impacted) and whether compensatory mitigation via habitat creation, enhancement, and/or preservation is appropriate. If such take is permissible and compensatory mitigation is appropriate, a compensatory mitigation plan will be developed by a qualified restoration ecologist, in consultation with the USFWS.
- If this species is detected within or adjacent to the project site, or if presence has been assumed on or adjacent to the site:
  - Clearing will be confined to the minimal area necessary to facilitate construction activities. Flag and designate avoided California tiger salamander habitat within or adjacent to the project area as Environmentally Sensitive Areas. This area should be avoided by all construction personnel.
  - Nighttime construction will be minimized.
  - If at any time a California tiger salamander is encountered during construction, activities shall cease until appropriate corrective measures have been completed or it has been determined that the salamander will not be harmed. Any sightings and any incidental take will be reported to the USFWS immediately by telephone at (916) 414-6600.
  - To eliminate an attraction to the predators of this species, all food-related trash items such as wrappers, cans, bottles, and food scraps will be disposed of in solid, closed containers (trash cans) and removed at the end of each working day from the entire construction site.
  - Tightly woven fiber netting or similar material shall be used for erosion control instead of plastic mono-filament netting to ensure that California tiger salamanders do not get trapped in this material. This limitation will be communicated to the contractor through use of Special Provisions included in the bid solicitation package.
  - Construction personnel will receive USFWS-approved worker environmental awareness training. Under this program, workers shall be informed about the presence of listed species and habitats associated with the species and that unlawful take of the species or destruction of its habitat is a violation of the FESA. Prior to construction activities, a qualified biologist approved by USFWS shall instruct all construction personnel about: (1) the description and status of the species; (2) the importance of their associated habitats; and (3) a list of measures being taken to reduce impacts to these species during project construction and

implementation. A fact sheet conveying this information shall be prepared for distribution to the construction crew and anyone else who enters the project site. This information will be kept on-site during all construction activities.

- A qualified biologist will identify possible additional measures specific to the project site in question that will avoid or minimize impacts to this species. Such measures might include maintenance of disturbance-free buffers around occupied/potential habitat, and around the watersheds of any ponds or pools in which this species might breed; use of ESA fencing to prevent inadvertent impacts to occupied/potential habitat; use of silt fencing to prevent inadvertent siltation of occupied/potential habitat and to prevent salamanders from moving into the project area; and dust control to prevent impacts to vernal pools and associated species from blowing dust.

California Red-legged Frog:

- A biologist will conduct a search of CNDDB records using the most recent updates to the database, and review other information (*e.g.*, from the USFWS or any previous studies conducted and documents prepared for the specific project in question or nearby projects), to determine if this species has been recorded on or within 5 miles of the project site.
- A qualified biologist will conduct a survey of the project site and immediately adjacent areas to determine whether habitat that may support this species is present on or within 200 feet of the site.
- If potential habitat for this species is present on or within 200 feet of the project site, then either:
  - Protocol-level surveys will be conducted by a qualified biologist to determine whether this species is present; or
  - Potential presence of the species will be assumed and the site will not be used for restoration; or
  - Potential presence of the species will be assumed and the project will be designed so that areas providing habitat for this species will not be adversely affected by restoration.
- If presence is assumed or California red-legged frogs are detected on the site, and avoidance of habitat is not practicable, then consultation with the USFWS during the project-specific section 7 consultation will identify whether take of the species is permissible (*e.g.*, depending on the extent of suitable/occupied habitat to be impacted) and whether compensatory mitigation via habitat creation, conservation, and/or preservation is appropriate. If such take is permissible and compensatory mitigation is appropriate, a compensatory mitigation plan will be developed by a qualified restoration ecologist, in consultation with the USFWS.

- If this species is detected within or adjacent to the project site, or if presence has been assumed on or adjacent to the site:
    - Clearing will be confined to the minimal area necessary to facilitate construction activities. Flag and designate avoided California red-legged frog habitat within or adjacent to the project area as ESAs. This area should be avoided by all construction personnel.
    - Nighttime construction will be minimized.
    - If at any time a California red-legged frog is encountered during construction, activities shall cease until appropriate corrective measures have been completed or it has been determined that the individual will not be harmed. Any sightings and any incidental take will be reported to the USFWS immediately by telephone at (916) 414-6600.
    - To eliminate an attraction to the predators of this species, all food-related trash items such as wrappers, cans, bottles, and food scraps will be disposed of in solid, closed containers (trash cans) and removed at the end of each working day from the entire construction site.
    - Tightly woven fiber netting or similar material shall be used for erosion control instead of plastic mono-filament netting to ensure that California red-legged frogs do not get trapped in this material. This limitation will be communicated to the contractor through use of Special Provisions included in the bid solicitation package.
    - Construction personnel will receive USFWS-approved worker environmental awareness training. Under this program, workers shall be informed about the presence of listed species and habitats associated with the species and that unlawful take of the species or destruction of its habitat is a violation of the FESA. Prior to construction activities, a qualified biologist approved by USFWS shall instruct all construction personnel about: (1) the description and status of the species; (2) the importance of their associated habitats; and (3) a list of measures being taken to reduce impacts to these species during project construction and implementation. A fact sheet conveying this information shall be prepared for distribution to the construction crew and anyone else who enters the project site. This information will be kept on-site during all construction activities.
    - A qualified biologist will identify possible additional measures specific to the project site in question that will avoid or minimize impacts to this species. Such measures might include maintenance of disturbance-free buffers around occupied/potential habitat, and around the watersheds of any ponds or pools in which this species might breed; use of ESA fencing to prevent inadvertent impacts to occupied/potential habitat; and use of silt fencing to prevent inadvertent siltation of occupied/potential habitat and to prevent red-legged frogs from moving into the project area.

Giant Garter Snake:

- A biologist will conduct a search of CNDDB records using the most recent updates to the database, and review other information (*e.g.*, from the USFWS or any previous studies conducted and documents prepared for the specific project in question or nearby projects), to determine if this species has been recorded on or within 5 miles of the project site. Because special-status snake records are typically suppressed by the CDFG in the CNDDB, a special request for this information from the CDFG will likely be required.
- A qualified biologist will conduct a survey of the project site and immediately adjacent areas to determine whether habitat that may support this species is present on or within 200 feet of the site.
- If potential habitat for this species is present on or within 200 feet of the project site, then presence will be assumed. In this case, either:
    - The site will not be used for restoration; or
    - The project will be designed so that areas providing habitat for this species will not be adversely affected by restoration (though additional avoidance and minimization measures will be implemented, as described below); or
    - If avoidance of impacts to this species is not practicable, or if impacting small numbers of individuals will allow for significant habitat enhancement through the proposed restoration, then consultation with the USFWS during the project-specific section 7 consultation will identify whether take of the species is permissible (*e.g.*, depending on the number of individuals or extent of suitable/occupied habitat to be impacted) and whether compensatory mitigation via habitat creation, enhancement, and/or preservation is necessary. If such take is permissible and compensatory mitigation is necessary, a compensatory mitigation plan will be developed by a qualified restoration ecologist, in consultation with the USFWS. If the project itself will create or enhance habitat conditions for the giant garter snake, then compensatory mitigation will not be necessary.
- If construction activities will occur in or within 200 feet of potential habitat for this species, the following measures, derived from the USFWS's *Standard Avoidance and Minimization Measures During Construction Activities in Giant Garter Snake Habitat*, will be implemented:
    - Construction activities within 200 feet of the banks of giant garter snake aquatic habitat will be avoided to the extent practicable. Confine movement of heavy equipment to existing roadways to the extent practicable to minimize habitat disturbance.
    - Construction activity within habitat will occur between May 1 and October 1 to the extent practicable. This is the active period for giant garter snakes and direct mortality is lessened, because snakes are expected to actively move and avoid danger. Between October 2 and April 30, work will occur only after consultation

with the Service's Sacramento Fish and Wildlife Office to determine if additional measures are necessary to minimize and avoid take.

- Clearing will be confined to the minimal area necessary to facilitate construction activities. Flag and designate avoided giant garter snake habitat within or adjacent to the project area as ESAs. This area should be avoided by all construction personnel.
- To eliminate an attraction to the predators of this species, all food-related trash items such as wrappers, cans, bottles, and food scraps will be disposed of in solid, closed containers (trash cans) and removed at the end of each working day from the entire construction site.
- Construction personnel will receive USFWS-approved worker environmental awareness training. Under this program, workers shall be informed about the presence of listed species and habitats associated with the species and that unlawful take of the species or destruction of its habitat is a violation of the FESA. Prior to construction activities, a qualified biologist approved by USFWS shall instruct all construction personnel about: (1) the description and status of the species; (2) the importance of their associated habitats; and (3) a list of measures being taken to reduce impacts to these species during project construction and implementation. A fact sheet conveying this information shall be prepared for distribution to the construction crew and anyone else who enters the project site. This information will be kept on-site during all construction activities.
- Within 24 hours prior to construction activities, the project area will be surveyed for giant garter snakes by a qualified biologist. Survey of the project area will be repeated if a lapse in construction activity of two weeks or greater has occurred. If a snake is encountered during construction, activities shall cease until appropriate corrective measures have been completed or it has been determined that the snake will not be harmed. Any sightings and any incidental take will be reported to the USFWS immediately by telephone at (916) 414-6600.
- Any dewatered habitat should remain dry for at least 15 consecutive days after April 15 and prior to excavating or filling of the dewatered habitat unless a qualified biologist can determine through thorough surveys that no garter snakes are present.
- After completion of construction activities, any temporary fill and construction debris will be removed and, wherever feasible, disturbed areas will be restored to pre-project conditions. Restoration work may include such activities as replanting species removed from banks or replanting emergent vegetation in the active channel.
- A qualified biologist will identify possible additional measures specific to the project site in question that will avoid or minimize impacts to this species.

California Clapper Rail:

- A biologist will conduct a search of CNDDB records using the most recent updates to the database, and review other information (*e.g.*, from the USFWS or any previous studies conducted and documents prepared for the specific project in question or nearby projects), to determine if this species has been recorded on or within 5 miles of the project site.
- A qualified biologist will conduct a survey of the project site and immediately adjacent areas to determine whether any salt marsh habitat that may support this species is present on the site, or in adjacent areas that could be directly or indirectly affected by the project (*e.g.*, by alteration of hydrology or by noise).
- If potential habitat for this species is present on the project site, or in adjacent areas that could be directly or indirectly affected by the project, then either:
    - Protocol-level surveys will be conducted by a qualified biologist to determine whether this species is present; or
    - Potential presence of the species will be assumed and the site will not be used for restoration; or
    - Potential presence of the species will be assumed and the project will be designed so that areas providing habitat for the species, as well as areas contributing to the hydrology of these habitat areas, will not be adversely affected by restoration.
- If surveys confirm that the species is present on a site, or if presence is assumed, and avoidance of impacts to this species is not practicable, then consultation with the USFWS during project-specific section 7 consultation will identify whether take of the species is permissible (*e.g.*, depending on the number of individuals or extent of suitable/occupied habitat to be impacted). For example, if impacting small numbers of individuals will allow for significant habitat enhancement through the proposed restoration, then the USFWS may determine that the incidental take associated with the restoration project is permissible. If such take is permissible, the project will proceed following the avoidance and minimization measures described below.
- If this species is detected within or adjacent to the project site, or if presence has been assumed on or adjacent to the site:
    - All activity within suitable vegetated marsh habitat will be minimized.
    - For any activities that involve walking through suitable marsh habitat repeatedly (*e.g.*, monitoring), different paths through the marsh will be taken during consecutive visits to minimize impacts to habitat in any given area. A route will be determined which will minimize the amount of foot traffic in the marsh and maximize the use of existing roads and trails.
    - Construction personnel will receive USFWS-approved worker environmental awareness training. Under this program, workers shall be informed about the presence of listed species and habitats associated with the species and that unlawful take of the species or destruction of its habitat is a violation of the

FESA. Prior to construction activities, a qualified biologist approved by USFWS shall instruct all construction personnel about: (1) the description and status of the species; (2) the importance of their associated habitats; and (3) a list of measures being taken to reduce impacts to these species during project construction and implementation. A fact sheet conveying this information shall be prepared for distribution to the construction crew and anyone else who enters the project site. This information will be kept on-site during all construction activities.

- Activities within or adjacent to clapper rail habitat will not occur within two hours of extreme high tides (6.5' or above, as measured at the Golden Gate Bridge), when the marsh plain is inundated, because protective cover for rails is limited and activities could prevent rails from reaching available cover.
- Activities within or adjacent to tidal marsh areas will be avoided during the clapper rail breeding season from February 1 through August 31 each year unless surveys are conducted to determine rail locations and rail territories can be avoided, or the marsh is determined to be unsuitable rail breeding habitat by a qualified biologist. If breeding rails are determined to be present, activities will not occur within 700 feet of an identified calling center. If the intervening distance across a major slough channel or across a substantial barrier between the rail calling center and any activity area is greater than 200 feet, then it may proceed at that location within the breeding season. *Exception*: Only inspection, maintenance, research, or monitoring activities may be performed during the clapper rail breeding season in areas within or adjacent to clapper rail breeding habitat with approval of USFWS and CDFG under the supervision of a qualified biologist.
- If a rail nest is encountered during the breeding season during any project-related activity, the observers will immediately leave the vicinity of the nest; and if rail adults are encountered, observers will move away from the birds if they are giving alarm calls or otherwise appear alarmed. The listed species contact will be immediately notified and all activity will cease until further direction is received from that person.
- A qualified biologist will identify possible additional measures specific to the project site in question that will avoid or minimize impacts to this species.

Western Snowy Plover/California Least Tern:

- A biologist will conduct a search of CNDDB records using the most recent updates to the database, and review other information (*e.g.*, from the USFWS or any previous studies conducted and documents prepared for the specific project in question or nearby projects), to determine if this species has been recorded on or within 5 miles of the project site.
- A qualified biologist will conduct a survey of the project site and immediately adjacent areas to determine whether any suitable nesting habitat that may support these species is

present on the site, or in adjacent areas that could be directly or indirectly affected by the project (*e.g.*, by alteration of hydrology or by noise).

- If potential habitat for these species is present on the project site, or in adjacent areas that could be directly or indirectly affected by the project, focused, breeding-season surveys will be conducted by a qualified biologist to determine whether these species are breeding on or near the site.
- If surveys confirm that one or both of these species is breeding on the site, or close enough to the site to be adversely affected by project activities, either
    - The site will not be used for restoration; or
    - The project will be designed so that areas providing suitable breeding habitat for these species will not be adversely affected by restoration; or
    - If avoidance of impacts to habitat of these species is not practicable, then consultation with the USFWS during project-specific section 7 consultation will identify whether take of the species is permissible (*e.g.*, depending on the number of individuals or extent of suitable/occupied habitat to be impacted) and whether compensatory mitigation via habitat creation, enhancement, and/or preservation is necessary. If such take is permissible and compensatory mitigation is necessary, a compensatory mitigation plan will be developed by a qualified restoration ecologist, in consultation with the USFWS.
- If one or both of these species is breeding on the site, or close enough to the site to be adversely affected by project activities:
    - Any construction activities performed during the breeding season, which is 1 March through 14 September for the western snowy plover and 15 April to 15 August for the California least tern, will be preceded by preconstruction surveys to determine whether and where nesting is occurring relative to the project site.
    - No activities will be performed within 300 feet of an active least tern nest or within 600 feet of an active snowy plover nest. *Exception*: Only inspection, maintenance, research, or monitoring activities may be performed during the least tern breeding season in areas within or adjacent to least tern breeding habitat with approval of USFWS and CDFG under the supervision of a qualified biologist.
- If snowy plover or least tern chicks are present and are foraging along any levee that will be accessed by vehicles (*e.g.*, for construction, inspection, or access), vehicle use will be under the supervision of a qualified biologist (to ensure that no chicks are present within the path of the vehicle).
- No water-level manipulation (*e.g.*, for management) within areas that contain suitable western snowy plover or California least tern habitat will be performed unless surveys confirm that these species are not actively nesting in the project area.
- During tidal restoration activities, no levees will be breached on ponds that provide suitable nesting habitat for these species during their respective breeding seasons unless surveys demonstrate that nesting snowy plovers and least terns are absent.

Salt Marsh Harvest Mouse:

- A biologist will conduct a search of CNDDB records using the most recent updates to the database, and review other information (*e.g.*, from the USFWS or any previous studies conducted and documents prepared for the specific project in question or nearby projects), to determine if this species has been recorded on or within 5 miles of the project site.
- A qualified biologist will conduct a survey of the project site and immediately adjacent areas to determine whether any salt marsh habitat that may support this species is present on the site, or in adjacent areas that could be directly or indirectly affected by the project (*e.g.*, by alteration of hydrology).
- If potential habitat for this species is present on the project site, or in adjacent areas that could be directly or indirectly affected by the project, then either:
    - Trapping surveys will be conducted by a qualified biologist to determine whether this species is present; or
    - Potential presence of the species will be assumed and the site will not be used for restoration; or
    - Potential presence of the species will be assumed and the project will be designed so that areas providing habitat for the species, as well as areas contributing to the hydrology of these habitat areas, will not be adversely affected by restoration.
- If trapping confirms that the species is present on a site, or if presence is assumed, and avoidance of impacts to this species is not practicable, then consultation with the USFWS will identify whether take of the species is permissible (*e.g.*, depending on the number of individuals or extent of suitable/occupied habitat to be impacted). For example, if impacting small numbers of individuals will allow for significant habitat enhancement through the proposed restoration, then the USFWS may determine that the incidental take associated with the restoration project is permissible. If such take is permissible, the project will proceed following the avoidance and minimization measures described below.
- If this species is detected within or adjacent to the project site, or if presence has been assumed on or adjacent to the site:
    - All activity within suitable vegetated marsh habitat will be minimized.
    - For any activities that involve walking through suitable marsh habitat repeatedly (*e.g.*, monitoring), different paths through the marsh will be taken during consecutive visits to minimize impacts to habitat in any given area. A route will be determined which will minimize the amount of foot traffic in the marsh and maximize the use of existing roads and trails.
    - Construction personnel will receive USFWS-approved worker environmental awareness training. Under this program, workers shall be informed about the presence of listed species and habitats associated with the species and that unlawful take of the species or destruction of its habitat is a violation of the

FESA. Prior to construction activities, a qualified biologist approved by USFWS shall instruct all construction personnel about: (1) the description and status of the species; (2) the importance of their associated habitats; and (3) a list of measures being taken to reduce impacts to these species during project construction and implementation. A fact sheet conveying this information shall be prepared for distribution to the construction crew and anyone else who enters the project site. This information will be kept on-site during all construction activities.

- To minimize or avoid the loss of individual salt marsh harvest mice from activities in habitat within tidal marsh areas, pickleweed vegetation will be hand-removed with a weed-eater (moving from the center outward) prior to any excavation, fill, or construction activities within salt marsh harvest mouse habitat. Vegetation removal will be limited to the minimum amount necessary to permit the activity to occur. Sufficient pickleweed habitat will remain adjacent to the activity area to provide refugia for displaced salt marsh harvest mice.
- Silt fences will be erected adjacent to construction areas to define and isolate potential mouse habitat. In areas of pickleweed removal, silt fences will be erected subsequent to vegetation clearing.
- Access through pickleweed vegetation during implementation of activities will be limited to trained personnel to avoid the disturbance of individual harvest mice. Those personnel accessing salt marsh harvest mouse habitat will walk carefully through the marsh, avoiding high pickleweed cover and wrack (where mice are likely to nest or find cover) whenever possible.
- Sites containing pickleweed habitat, and that will be inundated for the purpose of tidal marsh restoration, will be flooded slowly following breaching to allow salt marsh harvest mice within the project area to find refugia.
- In addition to the measures above, a qualified biologist will identify additional measures specific to the project site in question, if appropriate, to avoid or minimize impacts to the salt marsh harvest mouse. Such measures might include maintenance of disturbance-free buffers around occupied/potential habitat; use of ESA fencing to prevent inadvertent impacts to occupied/potential habitat; and dust control to prevent impacts to wetlands and associated plants from blowing sediment.

Delta Fish Agreement 2008 Amendment- Adaptive Management Strategy

This section describes key elements of the adaptive management strategy that relate to implementation of conservation actions pursuant to the 2008 Amendment to the Delta Fish Agreement. A variety of monitoring programs are in place and/or are being modified as part of the OCAP plan. Other portions of the BA describe adaptive management related to the operations of the pump facilities. The strategy outlined below only relates to key aspects of the 2008 Amendment conservation actions.

While a variety of activities will be funded by the amendment, the key new element will be the restoration of aquatic habitat in the Delta and Suisun Marsh to mitigate for impacts to surface acres of aquatic habitat in the Delta determined to have been impacted by the SWP Delta Pumping Facilities. However, as noted previously, this estimated range of mitigation acreage will be refined and the Export to Inflow ratio used to refine the estimate will be determined by the final OCAP BiOps issued by the USFWS and NMFS. Other programs (*e.g.*, restoration at Dutch Slough) have been designed to test various aspects of restoration techniques, and while not yet implemented, the process of design has already helped focus on the importance of land/tidal elevation on the chances of success and the costs of restoration. Additionally, the CDFG analysis of OCAP effects on delta smelt, based largely on Kimmerer and Nobriga (2008), emphasizes the importance of focusing restoration in areas of the Delta least affected by the operation of the pumps. Thus, the acres to be restored are primarily in the north portions of the Delta (*e.g.*, the Cache Slough complex) and the Suisun Marsh (*e.g.*, Hill Slough West). Other project specific actions to benefit salmonids (*e.g.*, Battle Creek, Deer Creek, Mill Creek, and others) have associated monitoring plans and adaptive management techniques already outlined, so are only referenced here.

The adaptive management strategy will focus on the outcome of the conservation actions. Namely:

1. Do the target species spawn, rear, or forage in the created habitats?
2. Is there a net export of nutrients to the adjacent open water?
3. Does *Egeria* or *Microsystis* invade the sites?
4. Does the restored habitat support increased populations of exotic predatory fish species?

Monitoring of these four key factors will be conducted to answer these questions, and the adaptive management plan (AMP) will focus on the measures that would need to be taken if the target species do not use these created habitats, if there is not a net export of nutrients, or if *Egeria*, *Microsystis*, or other exotic species invade the restoration sites. The tidal marsh conceptual models developed by the CALFED Delta Habitat Group (DHG) and the Dutch Slough working group were used to help focus the key questions and detail the hypotheses and uncertainties. The AMP will incorporate these in appropriate detail.

The AMP will discuss how monitoring and adaptive management will address each of these four key factors. Additionally, there are a suite of uncertainties dealing with restoring populations of the target species. The AMP, in addition to focusing on the key questions described above, will address other key uncertainties that are discussed below.

Following is an outline of the key elements of the adaptive management strategy, and associated monitoring and adaptive management tools that will be described in greater detail in the AMP.

1. Do the target species spawn, rear, or forage in the created habitats?

Delta and Longfin Smelt:

- Assumption: Restoration of tidal habitats, including marsh, channels, and shallow open water in the designated areas will increase habitat for delta smelt, and indirectly improve habitat for the longfin smelt. These habitats will be used and will contribute to the population viability of these species.
- Evidence:
  - Detection of delta smelt spawning, rearing, or foraging (if possible) in these restored habitats
  - Increases in the productivity of the Suisun Bay (described below), and therefore increased populations of longfin smelt
  - Increases in abundance indices for these species
- Monitoring:
  - Site-specific surveys
- Adaptation, if monitoring indicates the above assumptions are not met
  - Alter future restoration techniques and/or locations
  - Remedial actions on site
    - Alteration of tidal connections
    - Channel excavation
    - Raise bed elevation of marsh with supplemental materials
    - Increase/decrease tidal exchange

Salmonids:

- Assumption: Restoration of stream habitats and accessibility of those habitats, including dam removal and water augmentation, will increase spawning, rearing, and migration areas for salmon and California Central Valley steelhead. Tidal restoration in the Delta and Suisun Marsh will increase foraging, rearing, and migration habitat for these species, and for the Central California Coast steelhead. Projects in the Yolo Bypass will improve connectivity, increase productivity, and reduce stranding risk

associated with engineered weirs. Restored habitats will be used and will contribute to the population viability of these species.

- Evidence:
  - Detection of salmonid holding, spawning, foraging, or rearing in these restored habitats
  - Increases in abundance indices for the species
  - Increase in abundance and condition of juveniles detected in ongoing delta fish surveys (*e.g.* Kodiak trawl, beach seine survey, fish salvage)
- Monitoring:
  - Site-specific surveys
  - System-wide otolith and other hard tissue studies to determine if estuary rearing has increased
- Adaptation, if monitoring does not detect the species
  - Alter future restoration techniques and/or locations
  - Remedial actions on site
    - Alteration of restoration sites
    - Changes in flow regime

2. Is there a net export of nutrients to the adjacent open water?

- Assumption:
  - Creating new tidal marshes and flood plain habitat will increase productivity and export nutrients that will contribute to the productivity of the Delta and Suisun Bay
  - There will not be significant export of contaminants from these newly restored sites that will reduce the productivity of these waters or directly affect fish and invertebrate species therein
- Evidence:
  - Increase in nutrients and primary and secondary productivity in the Suisun Bay/Delta area
  - No increases in contaminant concentrations that significantly affect populations of aquatic organisms in the Delta or Suisun Bay
- Monitoring:
  - Site-specific monitoring of nutrient export from marshes
  - Area-wide monitoring of productivity (as part of the pelagic organism decline program)

  - Contaminant monitoring and food-chain bioaccumulation analysis (as part of the pelagic organism decline program)

- Adaptation, if monitoring does not detect the export of nutrients or does detect increased contaminants:
  - Alter site designs to increase primary productivity of the restored sites
  - Alter site designs to alter flows from sites
  - Contaminant remediation at sites to be restored, and/or more detailed pre-restoration analysis at potential restoration sites

3. Does *Egeria* or *Microsystis* invade the sites?

- Assumption:
  - Properly designed sites, in the portions of the Delta and Suisun Marsh proposed, will not be invaded by these species
- Evidence:
  - Little or no presence of these species
  - The site has appropriate hydrodynamic, temperature, and/or salinity and water quality characteristics to minimize or discourage invasion
- Monitoring:
  - Site-specific surveys
  - Water quality monitoring for dissolved oxygen, salinity, temperature, and other factors that could contribute to invasion by these species
- Adaptation, if monitoring detects invasion:
  - Determine if there are areas of shallow water with sluggish flows that could be changed by site modifications
  - Manual control of submerged aquatic vegetation if invasion is limited and local
    - Adjust locations and/or techniques of future restoration sites
    - Other site modifications

4. Does the restored habitat support increased populations of exotic, predatory fish species?

- Assumption:
  - Properly designed sites will not lead to an increase in these fish species
- Evidence:

  - No increase in abundance or diversity of these species
  - The site has appropriate hydrodynamic, physical, biological, and/or water quality characteristics to minimize or discourage an increase
- Monitoring:
  - Baseline pre-project site specific surveys (if these sites contain aquatic habitat prior to restoration)
  - Post-project site specific surveys
  - Water quality monitoring
- Adaptation, if monitoring detects invasion:
  - Site modification

Other Elements of the Adaptive Management Plan

The recent (September 2007) draft adaptive management plan for the Dutch Slough restoration project presents and discusses conceptual models for the restoration process, lists key uncertainties, selects two uncertainties for focus (the role of marsh plain elevation and the role of marsh scale), outlines specific hypotheses and monitoring strategies, designs restoration experiments, and discusses phasing. The adaptive management plan for the activities associated with the 2008 Amendment to the Delta Fish Agreement will develop a similar level of detail, focusing on the four key elements above, but incorporating other elements.

Table 1 from the Dutch Slough adaptive management plan categorizes key uncertainties relating to delta smelt habitat restoration. It is incorporated here to highlight elements that will also need to be considered in this adaptive management plan.

Table 1. Categories of Uncertainties

Fish Uncertainties

1. Are target fish populations habitat limited?
2. Are target fish populations food limited?
3. Are target fish populations predation limited?
   a. fish predators?
   b. bird predators?
4. Are fish populations limited by contaminants?
5. Do delta smelt spawn in marshes or channels?

Geomorphic-Habitat Type Uncertainties

1. What are important characteristics of open water vs. dendritic marsh for fish, birds,

meHg, and dissolved organic carbon (DOC)?

2. Value of large channels vs. small channels for fish and birds?
3. Value of large order channel networks vs. small order?
4. Relationship of channel density to fish utilization?
5. Fish, bird, mercury, and DOC benefits of low and high marsh plains?
6. What is the transport connection (fish, food, sediment, Hg, DOC) between marshes and channels?
7. How does shallow water habitat adjacent to tidal marsh affect the value of the marsh for fish?

Geomorphic Process Uncertainties

1. What factors influence slough channel development and sustainability?
2. What elevation of marsh plain will allow channel development or maintenance through scour?
3. Is marsh plain elevation influenced by sediment supply, peat accumulation, tidal range, initial elevation, subsidence and compaction?
4. Will marsh plain accretion keep pace with sea level rise?
5. What is the lowest elevation tules will establish and persist?
6. How will system respond to extreme events?

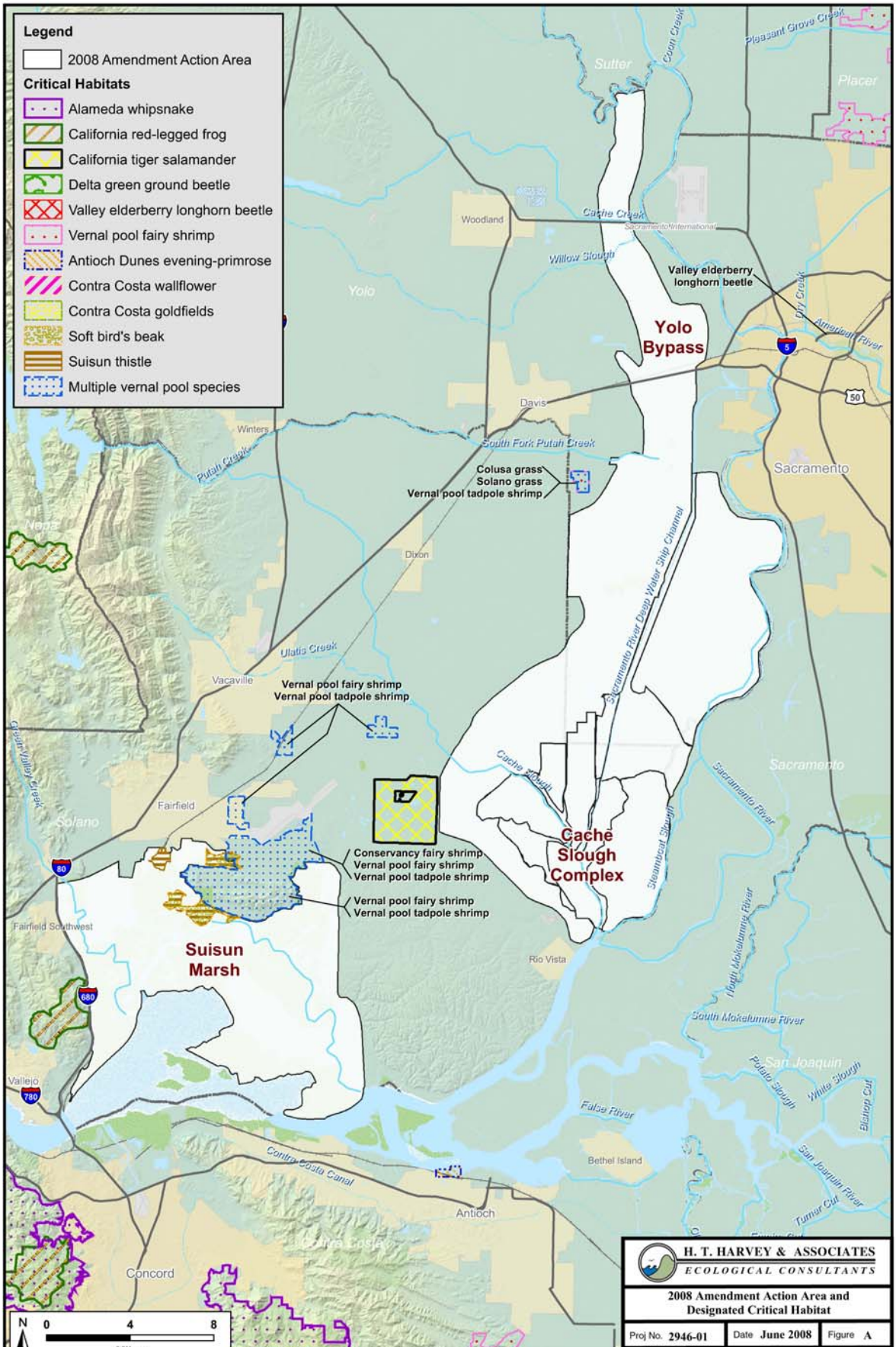
Submerged Aquatic Vegetation (SAV) Uncertainties

1. What is the relative stability of native SAV population?
2. What are the linkages of different SAV structure and fish habitat?
3. What is the role of SAV as habitat for invertebrates?
4. What fish and bird benefits occur from different aquatic plants?
5. Can we control SAV by managing submerged substrate?
6. What is the relationship between exotic SAV and exotic predatory fish?

Construction Feasibility Uncertainties

1. Can we build steep banked channels presumably preferred by fish?
2. Can we restore subsided lands with techniques other than placement of mineral soil fill material?

Financial Assurances. The 2008 Amendment to the Delta Fish Agreement provides for the funding for acquisition, transferring the sites to the CDFG, and site management. In addition, pursuant to the 2008 Amendment, plans for individual conservation actions shall include CDWR funding sufficient to accomplish full implementation of the action, which may include, restoration planning, environmental review, permitting, interim management prior to restoration, restoration implementation, operation and maintenance activities, and monitoring to evaluate project success in meeting the planned restoration objectives. The AMP will address costs of monitoring and site remediation, should adaptations to the site design be required.


Legend
2008 Amendment Action Area
Critical Habitats
Alameda whipsnake
California red-legged frog
California tiger salamander
Delta green ground beetle
Valley elderberry longhorn beetle
Vernal pool fairy shrimp
Antioch Dunes evening-primrose
Contra Costa wallflower
Contra Costa goldfields
Soft bird's beak
Suisun thistle
Multiple vernal pool species
Valley elderberry longhorn beetle
Yolo Bypass
Colusa grass
Solano grass
Vernal pool tadpole shrimp
Vernal pool fairy shrimp
Vernal pool tadpole shrimp
Conservancy fairy shrimp
Vernal pool fairy shrimp
Vernal pool tadpole shrimp
Vernal pool fairy shrimp
Vernal pool tadpole shrimp
Cache Slough Complex
Suisun Marsh
Sutter
Placer
Yolo
Woodland
Davis
Winters
Vacaville
Fairfield
Solano
Dixon
Sacramento
Rio Vista
Antioch
Concord
Vallejo
Fairfield Southwest
Bethel Island
Cache Creek
Willow Slough
South Fork Putah Creek
Putah Creek
Ulatis Creek
Cache Slough
Steamboat Slough
Sacramento River Deep Water Ship Channel
Sacramento River
North Mokelumne River
South Mokelumne River
False River
Contra Costa Canal
San Joaquin
Pleasant Grove Creek
Dry Creek
American River
White Slough
Bishop Cut
San Joaquin River
Turner Cut
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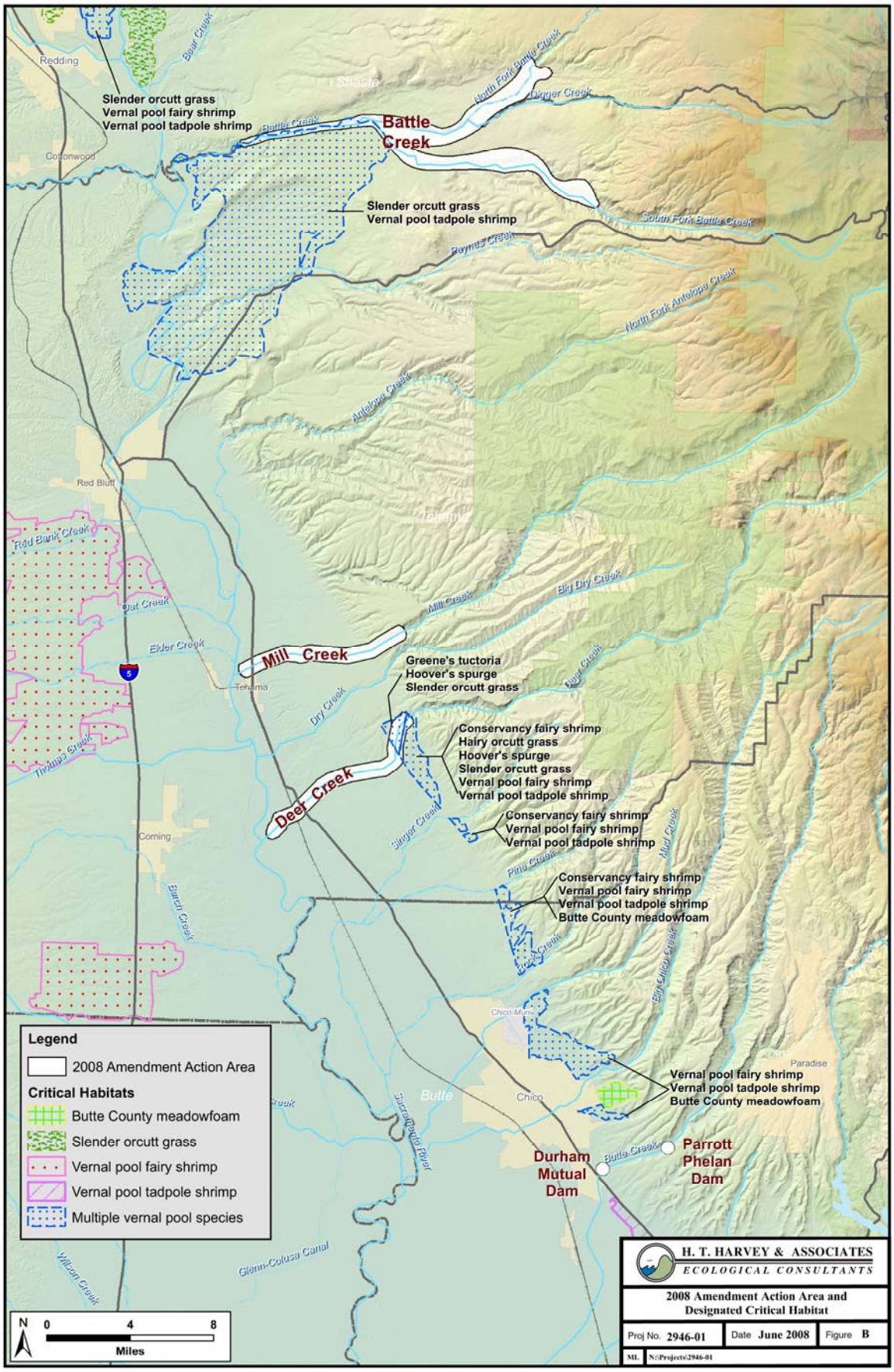
H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS
2008 Amendment Action Area and Designated Critical Habitat
Proj No. 2946-01
Date June 2008
Figure A


Redding
Bear Creek
Slender orcutt grass
Vernal pool fairy shrimp
Vernal pool tadpole shrimp
Battle Creek
Battle Creek
North Fork Battle Creek
Digger Creek
Cottonwood
Slender orcutt grass
Vernal pool tadpole shrimp
South Fork Battle Creek
Paynes Creek
North Fork Antelope Creek
Antelope Creek
Red Bluff
Tehama
Red Bank Creek
Oat Creek
Elder Creek
Mill Creek
Bird Dry Creek
Mill Creek
Greene's tuctoria
Hoover's spurge
Slender orcutt grass
Deer Creek
Dry Creek
Thomas Creek
Conservancy fairy shrimp
Hairy orcutt grass
Hoover's spurge
Slender orcutt grass
Vernal pool fairy shrimp
Vernal pool tadpole shrimp
Deer Creek
Conservancy fairy shrimp
Vernal pool fairy shrimp
Vernal pool tadpole shrimp
Corning
Stinger Creek
Mud Creek
Pine Creek
Conservancy fairy shrimp
Vernal pool fairy shrimp
Vernal pool tadpole shrimp
Butte County meadowfoam
Burch Creek
Big Chico Creek
Chico Marsh
Paradise
Vernal pool fairy shrimp
Vernal pool tadpole shrimp
Butte County meadowfoam
Butte
Chico
Sacramento River
Durham Mutual Dam
Butte Creek
Parrott Phelan Dam
Glenn-Colusa Canal
Willow Creek
Legend
2008 Amendment Action Area
Critical Habitats
Butte County meadowfoam
Slender orcutt grass
Vernal pool fairy shrimp
Vernal pool tadpole shrimp
Multiple vernal pool species
N
0
4
8
Miles
H. T. HARVEY & ASSOCIATES
ECOLOGICAL CONSULTANTS
2008 Amendment Action Area and Designated Critical Habitat
Proj No. 2946-01
Date June 2008
Figure B
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Delta Fish Agreement 2008 Amendment- Status of the Species

A detailed search of information available from the USFWS, CNDDB (2008) and other sources was conducted to identify the federally listed and proposed species, and designated critical habitat, that occurs within the Delta Fish Agreement 2008 Amendment (hereafter 2008 Amendment) action area. Several federally listed species known to occur within the general vicinity of the action area will not be affected by the 2008 Amendment conservation actions. Lange's metalmark (*Apodemia mormo langei*) and Contra Costa wallflower (*Erysimum capitatum var. anugstatum*) occur only in sand dune habitat in the Antioch Dunes area of northern Contra Costa County, and the Antioch Dunes evening primrose (*Oenothera deltoides* ssp. *howellii*) is found in the Antioch Dunes and on Brannan Island in Sacramento County. Neither of these areas will be affected, directly or indirectly, by the 2008 Amendment projects.

Other federally listed species that occur near, but not within, the 2008 Amendment action area include the riparian woodrat (*Neotoma fuscipes riparia*) and riparian brush rabbit (*Sylvilagus bachmani riparius*), which occur along the lower San Joaquin and Stanislaus Rivers near Caswell Memorial State Park and Vernalis in San Joaquin County; the delta green ground beetle (*Elaphrus viridis*) and San Joaquin Valley Orcutt grass (*Orcuttia inaequalis*), which occur just outside the action area in the greater Jepson Prairie area in south-central Solano County; Butte County meadowfoam (*Limnanthes floccosa* ssp. *californica*), which occurs in several locations between the Butte Creek and Deer Creek project areas but is not known to occur within the action area; palmate-bracted bird's beak (*Cordylanthus palmatus*), which occurs no closer to the action area than the Woodland area in Yolo County; Sacramento Orcutt grass (*Orcuttia viscida*), which occurs in eastern Sacramento County, east of the action area; fleshy owl's-clover (*Castilleja campestris* ssp. *succulenta*), one occurrence of which is present in the Southeastern Sacramento Valley Vernal Pool Region of San Joaquin County, south of the action area; and large-flowered fiddleneck (*Amsinckia grandiflora*), which occurs in Contra Costa County south of Antioch and in Alameda and San Joaquin Counties southwest of Tracy. The 2008 Amendment conservation actions will not occur in any of these areas, and will not affect these species or critical habitat designated for these species.

The California brown pelican (*Pelecanus occidentalis californicus*) occasionally occurs in Suisun Bay, but is not expected to occur in the marsh restoration areas near the landward edge of Suisun Marsh, as it is more typically associated with extensive, open, saltwater habitats.

Because of the expansive nature of the 2008 Amendment action area, the lack of detail regarding some of the potential conservation actions that have been identified, and the fact that some potential conservation actions have not yet been identified, a conservative approach has been taken when including listed species in the effects analysis. Thus, all federally listed species that have some potential to occur within the action area are described below, and effects of the project on these species are addressed in *Effects of the Proposed Programmatic Action* below, even if the probability of a species being affected by the conservation actions is very low.

Species accounts for the target fish species, which are the delta smelt, longfin smelt, Sacramento River winter-run Chinook salmon (hereafter "winter-run Chinook salmon"), and Central Valley spring-run Chinook salmon (hereafter "spring-run Chinook salmon"), as well as for other listed fish species addressed by this biological assessment, which are the California Central Valley steelhead, Central California Coast steelhead, and green sturgeon, have already been prepared for the OCAP biological assessment.

Soft Bird's Beak

Soft bird's-beak (*Cordylanthus mollis* ssp. *mollis*) was listed as federally endangered on 20 November 1997 (USFWS 1997b). The CNPS considers soft bird's-beak as endangered throughout its range, and the species is currently on List 1B (CNPS 2008). Critical habitat was designated for soft bird's-beak in 2007 (USFWS 2007d).

Soft bird's-beak is a member of the family Scrophulariaceae. According to the USFWS's listing notice and critical habitat designation, which contain more details regarding the biology and distribution of this species (USFWS 1997b, 2007d), the plant may grow to a height of 10-16 inches, with a few branches in its upper half containing hairy, grayish-green leaves. Like other members of the genus *Cordylanthus*, soft bird's-beak is partially parasitic on the roots of other plants. The species is typically found in the upper reaches of salt marshes where salt grass (*Distichlis spicata*), pickleweed (*Sarcocornia pacifica*), and marsh jaumea (*Jaumea carnosa*) are dominant, at or near the limits of tidal action. Here, soft bird's-beak is parasitic on these other plants. Soft bird's-beak is typically found in larger marshes with complex tidal channel networks (USFWS 1997b). This species typically occurs in fully tidal marshes, and although it can occur in muted tidal marshes it "does not readily occur" in diked wetlands (USFWS 2007d).

Soft bird's-beak is endemic to San Pablo Bay and Suisun Bay. Historically, the subspecies was found in high tidal marshes along the Petaluma River and Napa River through the Carquinez Strait to Suisun Bay and the San Joaquin-Sacramento River Delta in Marin, Sonoma, Napa, Solano, Contra Costa, and Sacramento Counties. The plant's current distribution consists of widely scattered populations from Point Pinole and Fagan Slough marsh through the Carquinez Strait to Suisun Bay in Napa, Solano, and Contra Costa Counties.

Habitat loss, fragmentation, and degradation have significantly impacted tidal marshes within the San Francisco Bay. Seventy-nine percent of historic tidal marshes have been lost in Suisun Bay. Most of the existing tidal marshes in Suisun Marsh are diked and managed for wildlife, especially wintering and migrating waterfowl. These impacts have altered the extent and composition of plant communities in the Suisun tidal marshes, and as a result, many native salt marsh plants such as soft bird's-beak are rare throughout the estuary.

At the time of listing in 1997, the USFWS (1997b) determined that the species was presumed extant at nine locations in tidal marshes along the fringes of San Pablo and Suisun Bays. Pt. Pinole, Rush Ranch, and Joice Island Bridge provided very limited habitat and supported few individuals, while a population at Fagan Slough was only slightly larger. The two largest populations were located at Hill Slough and Concord Naval Weapons Station, each providing

approximately 10 ac of habitat. Most sites supported 1000-6000 individuals, with the largest site supporting 150,000 plants (USFWS 2007d).

Extant populations of soft bird's-beak are threatened by a number of factors, including habitat conversion, water pollution, increases in salinity of tidal marshes due to upstream withdrawals of fresh water, habitat fragmentation, indirect effects of urbanization, competition with nonnative vegetation, insect predation, projects that alter natural tidal regimes, mosquito abatement activities, and erosion (USFWS 1997b). Special management considerations in these areas include hydrological modifications that could affect the depth, duration, frequency of tidal events, and salinity levels.

Within the 2008 Amendment action area, soft bird's-beak occurs only within the Suisun Marsh area. Here, the species occurs in the upper portions of tidal salt marshes, with records from the central, north-central, and northeastern portions of the marsh (LSA Associates 2007, CNDDB 2008). Designated critical habitat within the 2008 Amendment area is present in Hill Slough Marsh and the Rush Ranch/Grizzly Island Wildlife Area.

The potential 2008 Amendment conservation projects in the Suisun Marsh, such as the Hill Slough West Tidal Marsh Restoration project and Meins Landing Tidal Restoration project, will target the restoration of tidal action to diked areas. The CDFG (2005) determined that this species could potentially occur in the Hill Slough West Tidal Restoration project action area and identified measures to avoid and minimize impacts to the species if it is present. Given the presence of records from the Suisun Marsh, the species could potentially be present in the Meins Landing project area as well. However, neither of these areas provides high-quality, fully tidal marsh for this species. Soft bird's-beak could potentially be present in other parts of Suisun Marsh that could be targeted for tidal wetland restoration by the 2008 Amendment conservation actions.

Suisun Thistle

Suisun thistle (*Cirsium hydrophilum*) was listed as federally endangered on 20 November 1997 (USFWS 1997b). The CNPS considers Suisun thistle as endangered throughout its range, and the species is currently on List 1B (CNPS 2008). Critical habitat was designated for Suisun thistle in 2007 (USFWS 2007d).

Suisun thistle is a member of the family Asteraceae. According to the USFWS's listing notice and critical habitat designation, which contain more details regarding the biology and distribution of this species (USFWS 1997b, 2007d), the plant is a perennial herb that reaches a height of 3.0-4.5 ft. Suisun thistle occurs in the middle marsh to high marsh, and along tidal slough channels in irregularly flooded estuarine wetlands of the Suisun Marsh (Fiedler and Zebell 1995). It is often associated with narrowleaf cattail (*Typha angustifolia*), three-square (*Schoenoplectus robustus*) or American bulrush (*Schoenoplectus americanus*), Baltic rush (*Juncus balticus*), and saltgrass.

Most of the 71,100 ac of tidal marshes in Suisun Bay were converted to agricultural land, and then to diked seasonal wetlands used for waterfowl management. Only 9340 of tidal marsh remain within Suisun Marsh (USFWS 1997b). Most of the remaining tidal marshes are backed by steep levees, which provide little or no upland transitional habitat for Suisun thistle.

Threats to the species include tidal wetland conversions to diked, managed, or muted tidal marshes; changes to channel water salinity and tidal regimes; mosquito abatement activities; marsh invasions by non-native plants; plant-eating insects; urban, industrial, and agricultural encroachment; impacts from livestock overgrazing; feral pigs; and impacts from unauthorized foot and off-road vehicle traffic (USFWS 1997b). Competition from introduced species, including perennial pepperweed (*Lepidium latifolium*), is also a threat to populations of Suisun thistle. Other possible threats include an introduced weevil (*Rhinocyllus conicus*), which may be lowering reproduction rates, and *Phyciodes myllita* caterpillars, which caused significant damage to rosettes at the Rush Ranch population in 1996 (USFWS 1997b).

According to the USFWS (1997b, 2007d), Suisun thistle is restricted to Suisun Marsh in Solano County, where only four known populations of the species occur (LSA Associates 2007, CNDDB 2008). One population occurs within the CDFG's Peytonia Slough Ecological Preserve, however this population declined to a single individual plant in 1996. The remaining populations are distributed along the Cutoff Slough tidal marshes on the Rush Ranch property of the Solano Land Trust and on CDFG's Joice Island Unit of the Grizzly Island Wildlife Management Area (USFWS 1997b, CNDDB 2008). Several thousand individual plants are known to be present at Rush Ranch, however fewer individuals are present at Grizzly Island Wildlife Area.

Designated critical habitat for the species is present in three Units within the Suisun Marsh: Hill Slough Marsh, Peytonia Slough Marsh, and Rush Ranch/Grizzly Island Wildlife Area. Special management considerations in these areas include hydrological modifications that could affect the depth, duration, and frequency of tidal events and the degree of salinity in the channel water column.

Within the 2008 Amendment action area, Suisun thistle occurs only in the Suisun Marsh. The potential 2008 Amendment conservation projects in the Suisun Marsh, such as the Hill Slough West Tidal Marsh Restoration project and Meins Landing Tidal Restoration project, will target the restoration of tidal action to diked areas. The CDFG (2005) determined that this species could potentially occur in the Hill Slough West Tidal Restoration project action area and identified measures to avoid and minimize impacts to the species if it is present. Given the presence of records from the Suisun Marsh, the species could potentially be present in the Meins Landing project area as well. However, neither of these areas provides high-quality, fully tidal marsh for this species. Suisun thistle could potentially be present in other parts of Suisun Marsh that could be targeted for tidal wetland restoration by the 2008 Amendment conservation actions.

Hoover's Spurge

Hoover's spurge (*Chamaesyce hooveri*) was listed as federally threatened on 26 March 1997 (USFWS 1997a). The CNPS considers Hoover's spurge as endangered in a portion of its range (CNPS 2008), and the species is currently on List 1B. Critical habitat for Hoover's spurge was designated in 2005 (USFWS 2005a).

Hoover's spurge is a member of the spurge family Euphorbiaceae. This gray-green plant grows along the ground in mats 2.0 to 39.4 in in diameter (Broyles 1987, Stone *et al.* 1988). Hoover's spurge is a summer annual. Although the species is associated with vernal pools, it does not grow in standing water, and seeds germinate after water evaporates from seasonal pools (Alexander and Schlising 1997). Seedling survival appears to be low in years of below-average rainfall (Stone *et al.* 1988).

According to the USFWS's listing notice (USFWS 1997a), critical habitat designation (USFWS 2005a, 2006b), and recovery plan (USFWS 2005d), which contain more details regarding the biology and distribution of this species, Hoover's spurge occurs in vernal pools (Stone *et al.* 1988, Koutnik 1993) within a wide variety of soil types. In the Northeastern Sacramento Valley Vernal Pool Region, pools occupied by Hoover's spurge generally consist of acidic soils over iron-silica cemented hardpan. Most pools in which Hoover's spurge occurs in the San Joaquin Valley, Solano-Colusa, and Southern Sierra Foothills vernal pool regions are on neutral to saline-alkaline soils over lime-silica cemented hardpan or claypan (Broyles 1987, Stone *et al.* 1988, Sawyer and Keeler-Wolf 1995, CNDDB 2008).

Habitat for Hoover's spurge typically consists of vernal pools on alluvial fans or ancient stream terraces. These vernal pools may vary in size from 0.5 to 600 ac (Stone *et al.* 1988). Hoover's spurge occurs both along the margins and in the deepest portions of the dried pool-bed, though it does not grow in standing water (Stone *et al.* 1988, Alexander and Schlising 1997). Deeper pools with longer durations of inundation and less competition from other plants provide the highest-quality habitat for Hoover's spurge (Stone *et al.*1988).

Historically, Hoover's spurge has been located in the Northeastern Sacramento Valley, the San Joaquin Valley, the Soluna-Colusa area, and the Southern Sierra Foothills Vernal Pool Regions (Keeler-Wolf *et al.* 1998). As of 2005, this species was known from more than 30 extant occurrences in Tehama, Butte, Glenn, Stanislaus, Merced, and Tulare Counties (USFWS 2005d). The largest remaining population of Hoover's spurge is within the Northeastern Sacramento Valley Vernal Pool Region, where 14 extant occurrences are present within the Vina Plains area of Tehama and Butte Counties and one other site is present near Chico in Butte County. Other extant occurrences are present in the Southern Sierra Foothills Vernal Pool Region and the Sacramento National Wildlife Refuge in Glenn County. The remaining extant occurrence is on the Bert Crane Ranch in Merced County, within the San Joaquin Valley Vernal Pool Region (Keeler-Wolf *et al.* 1998, CNDDB 2008).

Hoover's spurge is threatened by habitat loss, particularly conversion of vernal pool habitat to agriculture, and competition from invasive species. Alteration of hydrology, such as construction of levees and other barriers to natural water flow, as well as runoff from adjacent agricultural operations, also threatens this species' habitat. Cattle trampling and high livestock

stocking rates may also damage populations (Stone *et al.* 1988). Special management considerations within this unit include hydrologic disruptions or modifications that may disturb vernal pool habitats and restrict or isolate the distribution of Hoover's spurge.

The recovery goals of this species are intertwined with those of numerous other federally listed species using vernal pools in California and southern Oregon (USFWS 2005d). Among the overall objectives of the vernal pool ecosystem recovery plan are:

- Ameliorate or eliminate the threats that caused the species to be listed as endangered or threatened and ameliorate any other newly identified threats in order to be able to delist these species.
- Ameliorate or eliminate the threats that affect the species of concern and ameliorate any other newly identified threats in order to conserve these species.
- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pools and vernal pool complexes within the recovery planning area to maintain viable populations of listed species and species of concern, and prevent additional threats from emerging over time. By doing so other vernal pool species that may be considered common today and additional species that have not yet been identified or described will be adequately conserved so that they will never need the protection of the Endangered Species Act.

Individual elements of the overall recovery strategy for vernal pool ecosystems in California and southern Oregon include protection of existing populations and the natural ecosystem functions that support them; adaptive habitat management, restoration, creation, and monitoring; conducting status surveys; conducting research on the species; and conducting public participation and outreach efforts to promote conservation of these ecosystems. Additional recovery strategy elements for vernal pool plants such as Hoover's spurge include research to identify pollinators and seed banking.

Occurrences of this species in the vicinity of the 2008 Amendment action area are confined to the Vina Plains area of Tehama and Butte County. The only 2008 Amendment conservation action that occurs in the vicinity of this species' known populations is the Deer Creek Water Exchange Program in Tehama County. Three extant records of Hoover's spurge are present in the vicinity of this project area (CNDDB 2008). One occurs approximately 6 mi northeast of Vina and 2.5 mi northeast of the end of Reed Orchard Road, in a vernal pool just east of Deer Creek surrounded by annual grassland and open blue oak woodland. The other two records occur several miles north of Deer Creek, also in vernal pools surrounded by annual grassland. Designated critical habitat for Hoover's spurge is present in Tehama County, and the northern portion of this unit overlaps the Deer Creek Water Exchange Program area. Potential habitat for the species may also be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area.

Hairy Orcutt Grass

Hairy Orcutt grass (*Orcuttia pilosa*) was listed as federally endangered on 26 March 1997 (USFWS 1997a). The CNPS considers hairy Orcutt grass as endangered throughout its range, and the species is currently on List 1B (CNPS 2008). Critical Habitat was designated for hairy Orcutt grass in 2005 (USFWS 2005d).

Hairy Orcutt grass is a member of the tribe Orcuttieae in the grass family Poaceae. The species grows in tufts of numerous stems, and the majority of the plant is hairy, giving the species an overall grayish appearance. According to the USFWS's listing notice (USFWS 1997a), critical habitat designation (USFWS 2005a, 2006b), and recovery plan (USFWS 2005d), hairy Orcutt grass is typically found on stream terraces and alluvial fans (Stone *et al.* 1988) in Northern Basalt Flow, Northern Claypan, and Northern Hardpan vernal pools (Sawyer and Keeler-Wolf 1995). Sizes of occupied pools may range from less than 1 acre to more than 600 acres (Stone *et al.* 1988). Hairy Orcutt grass may not grow in pools that do not have a sufficiently long hydroperiod (*e.g.*, that do not hold water at least until May; Alexander and Schlising 1997). Hairy Orcutt grass is known to occur at elevations from 85 feet in Glenn County to 405 feet in Madera County (CNDDB 2008) on both acidic and saline-alkaline soils and in pools with an iron-silica cemented hardpan or claypan.

Hairy Orcutt grass historically occurred in the Northeastern Sacramento Valley and Southern Sierra Foothills Vernal Pool Regions (Keeler-Wolf *et al.* 1998) in Tehama, Stanislaus, Madera, and Merced Counties (Hoover 1941, Crampton 1959, Reeder 1982, Stone *et al.* 1988, CNDDB 2008). Additional occurrences of hairy Orcutt grass have been discovered in Madera, Tehama, and Stanislaus Counties (CNDDB 2008). As of 2005, this species was known from approximately 27 extant occurrences in Tehama, Butte, Glenn, Stanislaus, and Madera Counties (USFWS 2005d). Currently, most extant populations of hairy Orcutt grass are concentrated in the Vina Plains in Tehama County, with some additional in the Southern Sierra Foothills Vernal Pool Region (CNDDB 2008).

All vernal pool species are threatened by habitat loss, however, specific threats to hairy Orcutt grass include agricultural and residential developments (Stone *et al.* 1988), landfill construction (USFWS 1997a), cattle grazing, and competition from invasive plants (Stone *et al.* 1988). Small population size also poses a threat to the species, as 6 of the extant populations consist of less than 100 individuals (CNDDB 2008). Special management considerations within this unit include hydrologic disruptions or modifications that may disturb vernal pool habitats and restrict or isolate the distribution of hairy Orcutt grass.

The recovery goals of this species are intertwined with those of numerous other federally listed species using vernal pools in California and southern Oregon (USFWS 2005d). Among the overall objectives of the vernal pool ecosystem recovery plan are:

- Ameliorate or eliminate the threats that caused the species to be listed as endangered or threatened and ameliorate any other newly identified threats in order to be able to delist these species.
- Ameliorate or eliminate the threats that affect the species of concern and ameliorate any other newly identified threats in order to conserve these species.

- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pools and vernal pool complexes within the recovery planning area to maintain viable populations of listed species and species of concern, and prevent additional threats from emerging over time. By doing so other vernal pool species that may be considered common today, and additional species that have not yet been identified or described, will be adequately conserved so that they will never need the protection of the Endangered Species Act.

Individual elements of the overall recovery strategy for vernal pool ecosystems in California and southern Oregon include protection of existing populations and the natural ecosystem functions that support them; adaptive habitat management, restoration, creation, and monitoring; conducting status surveys; conducting research on the species; and conducting public participation and outreach efforts to promote conservation of these ecosystems. Additional recovery strategy elements for vernal pool plants such as hairy Orcutt grass include research to identify pollinators and seed banking.

Occurrences of this species in the vicinity of the 2008 Amendment action area are confined to the Vina Plains area of Tehama and Butte County. The only 2008 Amendment conservation action that occurs in the vicinity of this species' known populations is the Deer Creek Water Exchange Program in Tehama County. One extant record of hairy Orcutt grass is present near the project area, in a large vernal pool surrounded by annual grassland approximately 6 mi northeast of Vina and 1.8 mi east/northeast of the end of Reed Orchard Road (CNDDB 2008). Designated critical habitat for hairy Orcutt grass is present in Tehama County, and the northern portion of this unit overlaps the Deer Creek Water Exchange Program area. Potential habitat for the species may also be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area.

Slender Orcutt Grass

Slender Orcutt grass (*Orcuttia tenuis*) was listed as federally threatened on 26 March 1997 (USFWS 1997a). The CNPS considers slender Orcutt grass as endangered throughout its range, and the species is currently on List 1B (CNPS 2008). Critical Habitat was designated for slender Orcutt grass in 2005 (USFWS 2005d).

Slender Orcutt grass is in the family Poaceae and the tribe Orcuttieae. Unlike hairy Orcutt grass, the plants are only sparsely hairy and grow as single stems or in small tufts. According to the USFWS's listing notice (USFWS 1997a), critical habitat designation (USFWS 2005a, 2006b), and recovery plan (USFWS 2005d), slender Orcutt grass is typically found on volcanic substrates (Crampton 1959, Corbin and Schoolcraft 1989) and grows in Northern Volcanic Ashflow and Northern Volcanic Mudflow vernal pools (Sawyer and Keeler-Wolf 1995). Pools in which this species has been found range in size from 0.2 to 111 ac (Stone *et al.* 1988). Slender Orcutt grass occurs at elevations as low as 90 feet in Sacramento County (Stone *et al.* 1988) and as high as 5,761 feet in Plumas County (B. Corbin *in litt.* 1999 in USFWS 2005d). Soil types that support

the grass range from slightly to strongly acidic (Stone *et al.* 1988) and from clay to sandy, silty, or cobbly loam (Corbin and Schoolcraft 1989, CNDDB 2008).

All vernal pool species are threatened by habitat loss, however, specific threats to slender Orcutt grass include urbanization, off-road vehicle use, and small population size. Historically, slender Orcutt grass was known to occur in 18 locations in Lake, Sacramento, Shasta, and Tehama Counties (Reeder 1982, Stone *et al.* 1988). Thirty-four additional occurrences of the species were discovered in the 1980s (Stone *et al.* 1988, CNDDB 2008). These occurrences were primarily located in the northeastern Sacramento Valley Vernal Pool Region of Tehama County, though some were also on the Vina Plains. Additional occurrences were located in the northwestern Sacramento Valley Vernal Pool Region, on the Stillwater and Millvill Plains of Shasta County, in the Modoc Plateau Vernal Pool Region in Shasta and Siskiyou Counties, and in Lake County and Sacramento County. As of 2005, this species was known from approximately 76 extant occurrences in nine California counties (USFWS 2005d). Populations of the species are primarily concentrated in Tehama County, as they were historically.

The recovery goals of this species are intertwined with those of numerous other federally listed species using vernal pools in California and southern Oregon (USFWS 2005d). Among the overall objectives of the vernal pool ecosystem recovery plan are:

- Ameliorate or eliminate the threats that caused the species to be listed as endangered or threatened and ameliorate any other newly identified threats in order to be able to delist these species.
- Ameliorate or eliminate the threats that affect the species of concern and ameliorate any other newly identified threats in order to conserve these species.
- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pools and vernal pool complexes within the recovery planning area to maintain viable populations of listed species and species of concern, and prevent additional threats from emerging over time. By doing so other vernal pool species that may be considered common today, and additional species that have not yet been identified or described, will be adequately conserved so that they will never need the protection of the Endangered Species Act.

Individual elements of the overall recovery strategy for vernal pool ecosystems in California and southern Oregon include protection of existing populations and the natural ecosystem functions that support them; adaptive habitat management, restoration, creation, and monitoring; conducting status surveys; conducting research on the species; and conducting public participation and outreach efforts to promote conservation of these ecosystems. Additional recovery strategy elements for vernal pool plants such as slender Orcutt grass include research to identify pollinators and seed banking.

Occurrences of this species in the vicinity of the 2008 Amendment action area are confined to the Vina Plains area of Tehama County. The only 2008 Amendment conservation actions that occur in the vicinity of this species' known populations are the Deer Creek Water Exchange Program and Battle Creek Salmon and Steelhead Restoration project in Tehama County. One

extant occurrence of the species is present north of the Deer Creek Water Exchange Program project boundaries, approximately 2.5 mi north/northeast of Vina, in 4 of the 5 Laniger Lakes. Two extant occurrences of the species are also located in vernal pools near the Battle Creek project boundaries, in vernal pools near Manton and Spring Branch Creek Roads (CNDDB 2008).

Two designated critical habitat units are located within the 2008 Amendment action area, present within Tehama County. One overlaps the western portion of the Battle Creek Phase 1 project, and supports occurrences of the species within vernal pools on Tuscan loam and Inks soils. The second unit overlaps the Deer Creek Water Exchange Program and contains large vernal pool complexes that represent some of the last remaining lower elevation vernal pool habitats in the northern Sacramento Valley. Special management considerations within both of these units include hydrologic disruptions or modifications that may disturb vernal pool habitats and restrict or isolate the distribution of slender Orcutt grass.

Greene's Tuctoria

Greene's tuctoria (*Tuctoria greenei*) was listed as federally endangered on 26 March 1997 (USFWS 1997a). The CNPS considers Greene's tuctoria as endangered throughout its range, and the species is currently on List 1B (CNPS 2008). Critical habitat was designated for Greene's tucturia in 2005 (USFWS 2005d).

This species is a member of the Ocruttieae tribe in the grass family Poaceae. Greene's tuctoria grows in tufts composed of several erect stems. According to the USFWS's listing notice (USFWS 1997a), critical habitat designation (USFWS 2005a, 2006b), and recovery plan (USFWS 2005d), population fluctuations are common for Greene's tuctoria, and populations that have no visible plants one year may reappear in large numbers in later years. These fluctuations may be due to annual variations in weather, particularly rainfall, as well as to changes in management.

Greene's tuctoria grows on terraces in Northern Basalt Flow, Northern Claypan, and Northern Hardpan vernal pools (Sawyer and Keeler-Wolf 1995). Pools found to be occupied by this species range in size from 0.01 to 8.4 acres, occur at elevations ranging from 110 to 3500 ft, and occur over iron-silica cemented hardpan or claypan (Stone *et al.* 1988, CNDDB 2008).

Historically, Greene's tuctoria was detected in Butte, Fresno, Madera, Merced, San Joaquin, Stanislaus, Tehama, and Tulare Counties. As of 2005, this species was known from approximately 22 extant occurrences in seven California counties (USFWS 2005d), with the majority occurring in the Northeastern Sacramento Valley Vernal Pool Region, particularly in the Vina Plains. Another concentration of the species is located in the Southern Sierra Foothills Vernal Pool Region.

In addition to threats of habitat loss that affect all vernal pool species, Greene's tuctoria is specifically threatened by grasshopper outbreaks, agricultural conversion, inappropriate livestock grazing practices, and small population size. Special management considerations within this unit

include hydrologic disruptions or modifications that may disturb vernal pool habitats and restrict or isolate the distribution of Greene's tuctoria.

The recovery goals of this species are intertwined with those of numerous other federally listed species using vernal pools in California and southern Oregon (USFWS 2005d). Among the overall objectives of the vernal pool ecosystem recovery plan are:

- Ameliorate or eliminate the threats that caused the species to be listed as endangered or threatened and ameliorate any other newly identified threats in order to be able to delist these species.
- Ameliorate or eliminate the threats that affect the species of concern and ameliorate any other newly identified threats in order to conserve these species.
- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pools and vernal pool complexes within the recovery planning area to maintain viable populations of listed species and species of concern, and prevent additional threats from emerging over time. By doing so other vernal pool species that may be considered common today, and additional species that have not yet been identified or described, will be adequately conserved so that they will never need the protection of the Endangered Species Act.

Individual elements of the overall recovery strategy for vernal pool ecosystems in California and southern Oregon include protection of existing populations and the natural ecosystem functions that support them; adaptive habitat management, restoration, creation, and monitoring; conducting status surveys; conducting research on the species; and conducting public participation and outreach efforts to promote conservation of these ecosystems. Additional recovery strategy elements for vernal pool plants such as Greene's tuctoria include research to identify pollinators and seed banking.

Occurrences of this species in the vicinity of the 2008 Amendment action area are confined to the Vina Plains area of Tehama and Butte Counties. The only 2008 Amendment conservation action that occurs in the vicinity of this species' known populations is the Deer Creek Water Exchange Program in Tehama County. The nearest population to this project site is located in a vernal pool along an intermittent stream in the series of Laniger Lakes, approximately 2.5 mi north/northeast of Vina (CNDDB 2008). Designated critical habitat for the species within the 2008 Amendment action area is present in Tehama County, and the northern portion of this unit overlaps the Deer Creek Water Exchange Program. Potential habitat for the species may also be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area.

Colusa Grass

Colusa grass (*Neostapfia colusana*) was listed as federally threatened on 26 March 1997 (USFWS 1997a). The CNPS considers Colusa grass as endangered throughout its range, and the species is currently on List 1B (CNPS 2008). Critical Habitat was designated for Colusa grass in 2005 (USFWS 2005d).

Colusa grass is a member of the Orcuttieae tribe in the grass family Poaeceae. According to the USFWS's listing notice (USFWS 1997a), critical habitat designation (USFWS 2005a, 2006b), and recovery plan (USFWS 2005d), Colusa grass exhibits fewer adaptations to existence underwater compared to other members of the Orcuttieae grasses (Keeley 1998). However, seeds remain dormant for several years, until they have been immersed, and they eventually germinate underwater (Crampton 1976, Griggs 1980, Keeley 1998). As a result, the seed bank for this species may be much larger than the observed population in a given year.

Colusa grass is found along the edges of alkaline basins in the Sacramento and San Joaquin Valleys and on alluvial fans and stream terraces along the San Joaquin Valley (Stone *et al.* 1988). The species' elevational range extends from 18 feet to about 350 feet at known sites (CNDDB 2008), and it grows in Northern Claypan and Northern Hardpan vernal pools (Sawyer and Keeler-Wolf 1995) that range in size from 0.02 to 618 acres. Ideal habitat for this species consists of deeper pools and stock ponds, which provide long inundation periods necessary for germination (EIP Associates 1999).

Colusa grass was originally known from Merced and Stanislaus Counties, but through November 2003 the CNDDB included 60 reported occurrences of the species in Colusa, Merced, Solano, Stanislaus, and Yolo Counties. As of 2005, this species was known from approximately 42 extant occurrences in Yolo, Solano, San Joaquin, Stanislaus, and Merced Counties, mostly in the Southern Sierra Foothills Vernal Pool Region (USFWS 2005d).

In addition to threats of habitat loss (*e.g.*, from agricultural conversion and urbanization) that affect all vernal pool species, Colusa grass is specifically threatened by inappropriate grazing management, flood control, competition from invasive plants, grasshopper herbivory, small population size, and contamination from agricultural runoff and waste, herbicides, and industrial chemicals (USFWS 2005d).

The recovery goals of this species are intertwined with those of numerous other federally listed species using vernal pools in California and southern Oregon (USFWS 2005d). Among the overall objectives of the vernal pool ecosystem recovery plan are:

- Ameliorate or eliminate the threats that caused the species to be listed as endangered or threatened and ameliorate any other newly identified threats in order to be able to delist these species.
- Ameliorate or eliminate the threats that affect the species of concern and ameliorate any other newly identified threats in order to conserve these species.
- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pools and vernal pool complexes within the recovery planning area to maintain viable populations of listed species and species of concern, and prevent additional threats

> from emerging over time. By doing so other vernal pool species that may be considered common today, and additional species that have not yet been identified or described, will be adequately conserved so that they will never need the protection of the Endangered Species Act.

Individual elements of the overall recovery strategy for vernal pool ecosystems in California and southern Oregon include protection of existing populations and the natural ecosystem functions that support them; adaptive habitat management, restoration, creation, and monitoring; conducting status surveys; conducting research on the species; and conducting public participation and outreach efforts to promote conservation of these ecosystems. Additional recovery strategy elements for vernal pool plants such as Colusa grass include research to identify pollinators and seed banking.

Most occurrences of Colusa grass are located in the San Joaquin Valley, and the species has not been recorded within the 2008 Amendment action area itself. However, it has been recorded in two areas immediately adjacent to the action area: the Davis Communications Annex (where critical habitat has been designated for the species), located immediately west of the Yolo Bypass portion of the action area in Yolo County, and in the Jepson Prairie/Olcott Lake area, located immediately west of the Cache Slough Complex component of the action area in Solano County (USFWS 2005d, LSA Associates 2007).

It is possible that Colusa grass does not occur in the 2008 Amendment action area, since it has not been recorded there. However, given the rarity of the species in the northern part of its range, and the presence of other vernal pool species such as vernal pool and Conservancy fairy shrimp and vernal pool tadpole shrimp in the Glide Tule Elk Reserve in the southwestern part of the Yolo Bypass and in the Elsie Gridley Mitigation Bank area near western edge of the Cache Slough Complex (CNDDB 2008, LSA Associates 2007), a conservative approach has been taken in including this species in the effects analysis and including BMPs for the species.

Solano Grass

Solano grass (*Tuctoria mucronata*), or Crampton's tuctoria, was listed as federally endangered on 28 September 1978 (USFWS 1978a). Solano grass is on the CNPS List 1B with the highest endangerment rating possible (CNPS 2008). Critical habitat was designated for Solano grass in 2005 (USFWS 2005d).

Solano grass is an annual grass in the Orcuttieae tribe endemic to deep vernal pools and alkaline playas in Pescadero soils (Crampton 1959). According to the USFWS's listing notice (USFWS 1997a), critical habitat designation (USFWS 2005a, 2006b), and recovery plan (USFWS 2005d), seeds germinate underwater during winter, and flowering occurs once these water bodies begin to dry, generally in April or May (Griggs and Jain 1983). Germination will not occur until there has been significant inundation, and as a result, many seeds may remain dormant in the soil for up to several years (Griggs and Jain 1983). Abnormally dry and wet conditions seem to be

unfavorable for Solano grass, and the largest populations have been observed after seasons of 17.7 to 23.6 in of precipitation (Holland 1987).

Because Solano grass requires vernal pools or alkaline playas that are subject to long periods of inundation (Crampton 1959), the number of individuals in a population can fluctuate depending on the depth and duration of the inundation (Griggs and Jain 1983). The retention of seed in the soil seed bank is thus critical for the survival of populations of this species (Crampton 1959, Griggs and Jain 1983).

Solano grass may have been more widely distributed in the flooded areas that occurred behind the low natural levees along waterways draining the west side of the Sacramento Valley prior to the conversion of much of this area to agricultural uses.

Solano grass has been recorded in only two locations: the Davis Communications Annex, located immediately west of the Yolo Bypass portion of the action area in Yolo County, and the Jepson Prairie/Olcott Lake area, located immediately west of the Cache Slough Complex component of the action area in Solano County (USFWS 2005d, LSA Associates 2007). The species is extremely rare; one of the Solano County locations supported only 3 plants in 2005, and at the other Solano County location, the species has not been observed since 1993 (USFWS 2005d). The Davis Communications Annex is being transferred to the Yolo County Parks Department as Yolo County Grasslands Park. Several thousand individual plants were observed at this site in 2000. The series of large vernal lakes on Pescadero clays between Jepson Prairie Preserve and Travis Air Force Base remains potential Solano grass habitat, and these pools may be suitable for protection and reintroduction (USFWS 1997a).

Threats to Solano grass include disking, excavation, herbicide runoff, industrial contaminants, alteration of hydrology, excessive livestock stocking rates, recreational uses of habitat, and competition from non-native plants such as perennial pepperweed (USFWS 1997a).

The recovery goals of this species are intertwined with those of numerous other federally listed species using vernal pools in California and southern Oregon (USFWS 2005d). Among the overall objectives of the vernal pool ecosystem recovery plan are:

- Ameliorate or eliminate the threats that caused the species to be listed as endangered or threatened and ameliorate any other newly identified threats in order to be able to delist these species.
- Ameliorate or eliminate the threats that affect the species of concern and ameliorate any other newly identified threats in order to conserve these species.
- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pools and vernal pool complexes within the recovery planning area to maintain viable populations of listed species and species of concern, and prevent additional threats from emerging over time. By doing so other vernal pool species that may be considered common today, and additional species that have not yet been identified or described, will be adequately conserved so that they will never need the protection of the Endangered Species Act.

Individual elements of the overall recovery strategy for vernal pool ecosystems in California and southern Oregon include protection of existing populations and the natural ecosystem functions that support them; adaptive habitat management, restoration, creation, and monitoring; conducting status surveys; conducting research on the species; and conducting public participation and outreach efforts to promote conservation of these ecosystems. Additional recovery strategy elements for vernal pool plants such as Solano grass include research to identify pollinators and seed banking.

Because none of the locations where Solano grass has been detected are within the 2008 Amendment action area, it is possible that the species does not occur in the action area. However, soils in the Pescadero series, which support all three known occurrences of the species, are present in a number of locations in the southern and western portions of the Cache Slough Complex, in the southern Yolo Bypass, and along the upper edges of the Suisun Marsh area. Given the rarity of the species in the northern part of its range, and the presence of other vernal pool species such as vernal pool and Conservancy fairy shrimp and vernal pool tadpole shrimp in the Glide Tule Elk Reserve in the southwestern part of the Yolo Bypass and in the Elsie Gridley Mitigation Bank area near western edge of the Cache Slough Complex (CNDDB 2008, LSA Associates 2007), a conservative approach has been taken in including this species in the effects analysis and including BMPs for the species.

Contra Costa Goldfields

Contra Costa goldfields (*Lasthenia conjugens*) was listed as Federally endangered on 18 June 1997 (USFWS 1997a). The CNPS considers Contra Costa goldfields rare and endangered (Powell 1974), and the species is currently on List 1B with the highest endangerment rating possible (CNPS 2008). Critical habitat was designated for Contra Costa goldfields in 2005 (USFWS 2005d).

Contra Costa goldfields is a small, ephemeral annual sunflower that typically occurs in moist depressions within open, grassy habitats. According to the USFWS's listing notice (USFWS 1997a), critical habitat designation (USFWS 2005a, 2006b), and recovery plan (USFWS 2005d), plants range in height from 4 to 12 inches and flower from March through June. Because Contra Costa goldfields is a vernal pool plant, seeds likely germinate in response to seasonal rains, and the plants mature in one growing season, dying back during the summer. As with other vernal pool species, this species most likely forms a persistent soil seed bank.

Contra Costa goldfields do not occur within tidal wetlands, but may occur in seasonal wetlands in the upland transition zone. The species is most often found in vernal pools, swales, moist flats, and depressions within grassland. In Solano County and on the shores of San Francisco Bay, Contra Costa goldfields grows in alkaline or saline-alkaline sites (P. Baye in litt. 2000a, 2000b in USFWS 2005d, CNDDB 2008). Vernal pool types in which the species is found are Northern Basalt Flow, Northern Claypan, and Northern Volcanic Ashflow (Sawyer and Keeler-Wolf 1995). Contra Costa goldfields typically occurs at elevations of 6 to 200 ft, though it has been found at higher elevations (CNDDB 2008).

Historically, Contra Costa goldfields occurred in seven vernal pool regions: Central Coast, Lake-Napa, Livermore, Mendocino, Santa Barbara, Santa Rosa, and Solano-Colusa (Keeler-Wolf *et al.* 1998). As of 2005, this species was known from approximately 24 extant occurrences in Mendocino, Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, and Monterey Counties (USFWS 2005d). The greatest concentration of this species is in the Solano-Colusa Vernal Pool Region, east of Fairfield in Solano County, where potential expansion of development from the City of Fairfield threatens existing populations. Other threats to the species include modification of hydrology supporting vernal pools, competition from nonnative plants, especially Italian ryegrass (*Lolium multiflora*), disking, grading, filling, ditch construction, and off-road vehicle use. Grazing management seems to be important in maintaining populations and controlling weed species.

The recovery goals of this species are intertwined with those of numerous other federally listed species using vernal pools in California and southern Oregon (USFWS 2005d). Among the overall objectives of the vernal pool ecosystem recovery plan are:

- Ameliorate or eliminate the threats that caused the species to be listed as endangered or threatened and ameliorate any other newly identified threats in order to be able to delist these species.
- Ameliorate or eliminate the threats that affect the species of concern and ameliorate any other newly identified threats in order to conserve these species.
- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pools and vernal pool complexes within the recovery planning area to maintain viable populations of listed species and species of concern, and prevent additional threats from emerging over time. By doing so other vernal pool species that may be considered common today, and additional species that have not yet been identified or described, will be adequately conserved so that they will never need the protection of the Endangered Species Act.

Individual elements of the overall recovery strategy for vernal pool ecosystems in California and southern Oregon include protection of existing populations and the natural ecosystem functions that support them; adaptive habitat management, restoration, creation, and monitoring; conducting status surveys; conducting research on the species; and conducting public participation and outreach efforts to promote conservation of these ecosystems. Additional recovery strategy elements for vernal pool plants such as Contra Costa goldfields include research to identify pollinators and seed banking.

In the 2008 Amendment action area, Contra Costa goldfields occurs only in the northern portion of the Suisun Marsh area, where there are several scattered occurrence records near the upland edge of the marsh. The CDFG (2005) determined that this species could potentially occur in the Hill Slough West Tidal Restoration project action area and identified measures to avoid and minimize impacts to the species if it is present. Given the presence of records from the Suisun Marsh, the species could potentially be present in the Meins Landing project area as well. Three

critical habitat units overlap with the Suisun Marsh area in the upper tidal regions in the northernmost portion of the marsh.

Conservancy Fairy Shrimp

The Conservancy fairy shrimp (*Branchinecta conservatio*) was listed as federally endangered on 19 September 1994 (USFWS 1994b). Critical habitat was designated for Conservancy fairy shrimp in 2005 (USFWS 2005a).

The Conservancy fairy shrimp is a small vernal pool crustacean. According to the USFWS's listing notice (USFWS 1994b), critical habitat designation (USFWS 2005a, 2006b), and recovery plan (USFWS 2005d), this species survives as a dormant cyst during the dry phase of its life cycle. Cysts lie dormant in the substrate of a pool until it dries and is then refilled by subsequent rains. When their habitat inundates, some of the cysts hatch and the nauplii (early larval form) swim into the upper water column (Eriksen and Belk 1999). The maturation rate of the species varies depending upon temperature and habitat (Helm 1998, Eriksen and Belk 1999). Helm (1998) reported the Conservancy fairy shrimp as reaching maturity in an average of 49 days.

Predator consumption of fairy shrimp cysts aids in dispersal of the species. Predators such as birds and amphibians may excrete viable cysts in their excrement, often at locations other than those where they were consumed (Proctor 1964, Wissinger *et al.* 1999). These transported cysts may hatch at the new location and potentially establish a new population, if they are released in suitable habitat. Cysts may also be transported by wind and in mud carried on the feet of animals, including livestock that may wade through habitat.

The Conservancy fairy shrimp typically occurs in large, deep, neutral to slightly alkaline vernal pools that are low in dissolved salts, dominated by vernal pool plants, and that support a variety of vernal pool invertebrates (Eriksen and Belk 1999). This species is usually found at elevations below 475 ft in the Central Valley, although a Ventura County occurrence is located at 5577 ft (Eriksen and Belk 1999). Deep pools will pond sufficiently long enough to allow the shrimp to complete their life cycle, which may take 49 days or more (Helm 1998, Eriksen and Belk 1999).

The Conservancy fairy shrimp is endemic to California's Central Valley, with one outlying population in Ventura County, southwest of the Valley. Currently, eight populations ranging from the Vina Plains area of Butte and Tehama Counties south to Los Padres National Forest in Ventura County are known (USFWS 2005d).

The greatest threat to vernal pool invertebrates is the elimination, loss, or modification of their habitat by urban and agricultural development. Modification of the hydrology supporting vernal pools, invasion of pools by nonnative plants, and inappropriate grazing are also important threats (USFWS 2007a).

The recovery goals of this species are intertwined with those of numerous other federally listed species using vernal pools in California and southern Oregon (USFWS 2005d). Among the overall objectives of the vernal pool ecosystem recovery plan are:

- Ameliorate or eliminate the threats that caused the species to be listed as endangered or threatened and ameliorate any other newly identified threats in order to be able to delist these species.
- Ameliorate or eliminate the threats that affect the species of concern and ameliorate any other newly identified threats in order to conserve these species.
- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pools and vernal pool complexes within the recovery planning area to maintain viable populations of listed species and species of concern, and prevent additional threats from emerging over time. By doing so other vernal pool species that may be considered common today, and additional species that have not yet been identified or described, will be adequately conserved so that they will never need the protection of the Endangered Species Act.

Individual elements of the overall recovery strategy for vernal pool ecosystems in California and southern Oregon include protection of existing populations and the natural ecosystem functions that support them; adaptive habitat management, restoration, creation, and monitoring; conducting status surveys; conducting research on the species; and conducting public participation and outreach efforts to promote conservation of these ecosystems.

In the 2008 Amendment action area, Conservancy fairy shrimp occur in three general areas: the Glide Tule Elk Reserve in the southwestern part of the Yolo Bypass; the base of the Potrero Hills near the northeastern portion of the Suisun Marsh area; and the Vina Plains Preserve area in Tehama and Butte Counties, immediately south of the Deer Creek Flow Enhancement Program (CNDDB 2008, LSA Associates 2007). Potential habitat for the species may also be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area.

Designated critical habitat for the species in the vicinity of the 2008 Amendment action area is present immediately southeast of the lower reach of Deer Creek, which is the focus of the Deer Creek Water Exchange Program (critical habitat unit 1A) and in the Potrero Hills in the northeastern part of the Suisun Marsh area (critical habitat unit 3). The CDFG (2005) determined that no listed vernal pool branchiopods were present within the Hill Slough West Tidal Restoration project action area, and the species is unlikely to be present in the Meins Landing project area either, but it could potentially occur in upland areas at the edges of diked marshes that may be restored in Suisun Marsh.

Vernal Pool Fairy Shrimp

The vernal pool fairy shrimp (*Branchinecta lynchi*) was listed as federally threatened on 19 September 1994 (USFWS 1994b). Critical habitat for the species was designated in 2005 (USFWS 2005a).

According to the USFWS's listing notice (USFWS 1994b), critical habitat designation (USFWS 2005a, 2006b), and recovery plan (USFWS 2005d), the life cycle of the vernal pool fairy shrimp is very similar to that described above for the Conservancy fairy shrimp, consisting of a dormant cyst stage during the dry season and an aquatic larval and adult stage after vernal pools fill with water.

This species occurs fairly widely, with 395 occurrences in 25 California counties (plus Jackson County, Oregon) known as of 2006 (USFWS 2007b). This species is found in a number of widely scattered areas from southern Oregon south through the Central Valley, and in fewer locations in the coast ranges from the vicinity of San Francisco Bay area south to Riverside County. Habitats supporting the vernal pool fairy shrimp typically occur in Central Valley California floristic provinces below 984 ft elevation. In California, vernal pool fairy shrimp occur in vernal pools, seasonally ponded areas within vernal swales, ephemeral pools on rock outcrops, playas, and alkali flats (Eng *et al.* 1990).

The greatest threat to vernal pool invertebrates is the elimination, loss, or modification of their habitat by urban and agricultural development. Modification of the hydrology supporting vernal pools, invasion of pools by nonnative plants, and inappropriate grazing are also important threats (USFWS 2007b).

The recovery goals of this species are intertwined with those of numerous other federally listed species using vernal pools in California and southern Oregon (USFWS 2005d). Among the overall objectives of the vernal pool ecosystem recovery plan are:

- Ameliorate or eliminate the threats that caused the species to be listed as endangered or threatened and ameliorate any other newly identified threats in order to be able to delist these species.
- Ameliorate or eliminate the threats that affect the species of concern and ameliorate any other newly identified threats in order to conserve these species.
- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pools and vernal pool complexes within the recovery planning area to maintain viable populations of listed species and species of concern, and prevent additional threats from emerging over time. By doing so other vernal pool species that may be considered common today, and additional species that have not yet been identified or described, will be adequately conserved so that they will never need the protection of the Endangered Species Act.

Individual elements of the overall recovery strategy for vernal pool ecosystems in California and southern Oregon include protection of existing populations and the natural ecosystem functions that support them; adaptive habitat management, restoration, creation, and monitoring; conducting status surveys; conducting research on the species; and conducting public participation and outreach efforts to promote conservation of these ecosystems.

In the 2008 Amendment action area, vernal pool fairy shrimp occur in a limited area in the Glide Tule Elk Reserve in the southwestern part of the Yolo Bypass; at the base of the Potrero Hills near the northeastern portion of the Suisun Marsh area; and in the Vina Plains Preserve area in Tehama and Butte Counties, immediately south of the Deer Creek Flow Enhancement Program. Potential habitat for the species may also be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area.

Designated critical habitat for vernal pool fairy shrimp is present in the 2008 Amendment action area immediately southeast of the lower reach of Deer Creek, which is the focus of the Deer Creek Water Exchange Program (critical habitat unit 7A), and in the Potrero Hills in the northeastern part of the Suisun Marsh area (critical habitat unit 16A).

Vernal Pool Tadpole Shrimp

The vernal pool tadpole shrimp (*Lepidurus packardi*) was designated as federally endangered throughout its range on 19 September 1994 (USFWS 1994b). Critical habitat for the species was designated in 2005 (USFWS 2005a).

According to the USFWS's listing notice (USFWS 1994b), critical habitat designation (USFWS 2005a, 2006b), and recovery plan (USFWS 2005d), the life cycle of the vernal pool fairy shrimp is similar to that described above for the Conservancy fairy shrimp, consisting of a dormant cyst stage during the dry season and an aquatic larval and adult stage after vernal pools fill with water. Individuals may spend most of their lives as dormant cysts, which may remain viable for up to 10 years. When these cysts are inundated in vernal pools, some hatch into tadpole shrimp, which live only as long as the pool retains water. Unlike most fairy shrimp, juvenile vernal pool tadpole shrimp develop slowly, and thus a longer hydroperiod (about 7 to 8 weeks) is needed for these individuals to reach reproductive maturity (Gallagher 1996, Helm 1998). As a result, ideal habitat for this species may consist of deeper pools, that hold water longer, than those used by fairy shrimp.

The vernal pool tadpole shrimp occurs in sparsely vegetated, muddy or grass-bottomed vernal pools and swales on old alluvial soils that are underlaid by hardpan (USFWS 1994b). Inhabited pools typically contain clear to highly turbid water with very low conductivity, total dissolved solids, and alkalinity. This species is found in a number of widely scattered areas in the Central Valley, from Shasta County south into the San Joaquin Valley (with outlying occurrences in Contra Costa and Alameda Counties).

This species occurs fairly widely, with 226 occurrences in 19 California counties (plus Jackson County, Oregon) known as of 2006 (USFWS 2007c). The largest concentration of vernal pool tadpole shrimp occurs in the Southeastern Sacramento Vernal Pool Region, where the species occurs on a number of public and private lands in Sacramento County.

Widespread destruction and degradation of vernal pool habitats has reduced the species' distribution from historical times. Vernal pool habitats in the Central Valley now represent only about 25 percent of their former area, and the habitats that remain are very fragmented and isolated (Holland 1998). Vernal pool tadpole shrimp are now uncommon even in extant vernal pool habitats. Helm (1998) found vernal pool tadpole shrimp in only 17 percent of vernal pools sampled across 27 counties, and Sugnet (1993) found this species at only 11 percent of 3,092 locations.

Principal threats to the vernal pool tadpole shrimp include flood control, highway and utility projects, urban development, and conversion of native habitats to agriculture (USFWS 1994b). Activities that alter the hydrologic regime of vernal pools may adversely affect the species as well.

The recovery goals of this species are intertwined with those of numerous other federally listed species using vernal pools in California and southern Oregon (USFWS 2005d). Among the overall objectives of the vernal pool ecosystem recovery plan are:

- Ameliorate or eliminate the threats that caused the species to be listed as endangered or threatened and ameliorate any other newly identified threats in order to be able to delist these species.
- Ameliorate or eliminate the threats that affect the species of concern and ameliorate any other newly identified threats in order to conserve these species.
- Promote natural ecosystem processes and functions by protecting and conserving intact vernal pools and vernal pool complexes within the recovery planning area to maintain viable populations of listed species and species of concern, and prevent additional threats from emerging over time. By doing so other vernal pool species that may be considered common today, and additional species that have not yet been identified or described, will be adequately conserved so that they will never need the protection of the Endangered Species Act.

Individual elements of the overall recovery strategy for vernal pool ecosystems in California and southern Oregon include protection of existing populations and the natural ecosystem functions that support them; adaptive habitat management, restoration, creation, and monitoring; conducting status surveys; conducting research on the species; and conducting public participation and outreach efforts to promote conservation of these ecosystems.

In the 2008 Amendment action area, vernal pool tadpole shrimp occur in the following areas:

- a limited area in the Glide Tule Elk Reserve in the southwestern part of the Yolo Bypass;
- at the base of the Potrero Hills near the northeastern portion of the Suisun Marsh area, and in the Montezuma Wetlands project area in the eastern portion of the Suisun Marsh;
- in the Elsie Gridley Mitigation Bank and vicinity at the very western edge of the Cache Slough Complex.

- at the Vina Plains Preserve area in Tehama and Butte Counties, immediately south of the Deer Creek Flow Enhancement Program; potential habitat for the species may be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area.
- in the area on the south side of Battle Creek near the Battle Creek Salmon and Steelhead Restoration project area.

Critical habitat for the species is present in the 2008 Amendment action area along the south side of Battle Creek in the vicinity of the Battle Creek Salmon and Steelhead Restoration project (critical habitat unit 2B); immediately southeast of the lower reach of Deer Creek, which is the focus of the Deer Creek Water Exchange Program (critical habitat unit 3A); and in the Potrero Hills in the northeastern part of the Suisun Marsh area (critical habitat unit 11D).

Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) was listed as a threatened species with critical habitat on 8 August 1980 (USFWS 1980). On 2 October 2006, the USFWS announced its recommendation to remove the valley elderberry longhorn beetle from the endangered species list.

According to the USFWS listing notice (USFWS 1980) and recovery plan (USFWS 1984a), the valley elderberry longhorn beetle is very closely associated with the elderberry host plant (*Sambucus* spp., primarily *S. mexicana* and *S. caerulea*). Female valley elderberry longhorn beetles lay their eggs in bark crevices on the elderberry. The larvae bore into the wood of the host plant and feed on the central pith of stems. The adult eventually emerges through an exit hole, and adults are able to fly from shrub to shrub.

The elderberry shrubs used by this species occur in riparian forests throughout the Central Valley. Although they occasionally occur outside of riparian areas, those shrubs supporting the greatest beetle densities are located in areas where the shrubs are abundant and interspersed among dense riparian forest (Barr 1991, Collinge *et al.* 2001). Isolated elderberry shrubs separated from contiguous habitat by extensive development are not typically considered high-quality habitat for valley elderberry longhorn beetles (Collinge *et al.* 2001).

The valley elderberry longhorn beetle occurs in portions of the California Central Valley below about 3000 feet elevation. Originally thought to be very rare when it was listed in 1980, the species has since been recorded in approximately 190 locations (USFWS 2008).

Habitat of the valley elderberry longhorn beetle has been reduced and fragmented by clearing for agriculture, development, flood control, and construction of levees and dams. Habitat fragmentation also threatens the valley elderberry longhorn beetle; development isolates small patches of riparian forest and may prevent genetic flow between occupied areas of habitat, isolating metapopulations (Collinge *et al.* 2001). Non-native invasive species and over-grazing in riparian areas also represent threats to the valley elderberry longhorn beetle.

The objectives of the recovery plan (USFWS 1984a) are to protect occupied habitat; to conduct surveys to better determine the locations of the species so that occupied habitat can be protected; to restore habitat, including the removal of nonnative plants; and to minimize the use of herbicides and insecticides, removal of riparian vegetation, and prevent riprapping of longhorn beetle habitat. Since the valley elderberry longhorn beetle was listed in 1980, numerous distributional studies have been conducted (summarized in Barr 1991, Halstead and Oldham 2000), and the species has been found to be more widespread than previously thought. On 2 October 2006, the USFWS announced its recommendation to remove the valley elderberry longhorn beetle from the endangered species list.

CNDDB (2008) records in the vicinity of the 2008 Amendment action area include records along the Sacramento River in the northern Yolo Bypass area (near the Fremont Weir project and at locations both north and south of the Yolo Bypass tie-in to the Sacramento River on the northwest side of the Sacramento River). This species is also present along the Sacramento River near the 2008 Amendment conservation action areas in the northern Sacramento Valley. Jones & Stokes (2005) indicated that suitable habitat is present at a number of dams in the Battle Creek Salmon and Steelhead Restoration project, and because the species occurs along at least the lower portions of several tributaries to the Sacramento River in this area, it could potentially be present in the action areas for the Battle Creek Salmon and Steelhead Restoration project, Deer Creek Flow Enhancement Program, Mill Creek Water Exchange Program, Mill Creek Water Right Opportunities project, and Parrott Phelan and Durham Mutual Dam fish ladder and screen maintenance project. Elderberry shrubs are present on levees in some parts of the Delta as well. Although there are no CNDDB records of the valley elderberry longhorn beetle in the Delta proper, the USACE and CDWR (2001) determined that elderberry shrubs along the northern portion of the ship channel at Prospect Island could potentially support the longhorn beetle, and this species could occur along levees and in riparian areas at other potential project sites in the Delta. Critical habitat for the valley elderberry longhorn beetle has been designated, but is restricted to small areas in Sacramento County (USFWS 1980), outside the 2008 Amendment action area.

California Tiger Salamander

The central population of California tiger salamander (*Ambystoma californiense*) was listed as federally threatened on 4 August 2004 (USFWS 2004). Critical habitat was designated in 19 counties for the central population in 2005 (USFWS 2005b).

According to the listing notice (USFWS 2004) and critical habitat designation (USFWS 2005b), California tiger salamanders occur for most of their lives in subterranean refuge sites, usually in small mammal burrows, but also in crevices in the soil. Mammals providing such burrows commonly include California ground squirrels (*Spermophilus beecheyi*) and Botta's pocket gophers (*Thomomys bottae*). These sites are typically referred to as "aestivation" sites, although the exact behavior of tiger salamanders in refuge sites is not fully understood.

After winter rains have moistened the ground, the salamanders emerge from their refugia and migrate to breeding pools. Females deposit eggs in the water, and attach them to submerged vegetation or debris. Females may lay eggs twice in a single season (USFWS 2004). Lifetime reproductive success of females is fairly low; females in one study bred an average of 1.4 times in their lives, producing about 11 young each (Trenham *et al.* 2000). Adults may live more than 10 years, but do not reproduce until they are 4 to 5 years old (Trenham et al. 2000). Eggs take 10 to 14 days to hatch. Aquatic juveniles usually complete metamorphosis after 3 to 6 months. Generally ephemeral breeding ponds dry up during summer months, but over-summering larvae have been observed (Shaffer *et al.* 1993). Following metamorphosis, juveniles spend a few days at the pond margin, and then migrate to refuge sites.

California tiger salamanders inhabit grasslands and open oak woodlands in central and northern California. Breeding pools are usually ephemeral pools (*e.g.*, vernal pools), but water must remain present long enough for metamorphosis to occur (typically about 3 months). Permanent ponds are also used for breeding, but larger ponds often contain fish predators that consume eggs and larvae and prevent successful breeding.

California tiger salamanders have been known to disperse 1.6 km (1 mile) or more overland between breeding sites, or between a breeding site and upland habitat. In Santa Barbara County, an individual was recorded 1.4 km (0.9) mi from the nearest pond, and 1.7 km (1.1 mi) from the pond to which the observer thought the salamander was traveling (Dr. Sam Sweet, pers. comm. to J. Wilkinson, 10 February 2006, and to S. Rottenborn, 28 April 2006). California tiger salamanders at Stanford University have been recorded up to 1.6 km (1.0 mi) from their breeding pond (Dr. Alan Launer, pers. comm. to Steve Rottenborn, 24 February 2006), and Austin and Shaffer (1992) reported dispersal distances of at least 1.6 km (1.0 mi). Trenham *et al.* (2001) observed a high probability of adult California tiger salamander dispersing between pools up to 670 m (2,198 ft) apart but did not observe dispersal events longer than 700 m (2,297 ft). Trenham and Shaffer (2005) estimated 50, 90, and 95% of adult California tiger salamander were within 150, 490, 620 m (492, 1,608, 2,034 ft) of their study pond, respectively, and that 95% of juvenile California tiger salamander were within 630 m (2,067 ft) of the pond, with 85% concentrated between 200 and 600 m (656 and 1,969 ft), but none were found at 800 m (2,625 ft). However, Orloff (2007) reported longer-distance dispersal by a few individuals in a population in Pittsburgh, Contra Costa County; her results suggested that some individuals may be been traveling up to 2.2 km (>1.3 mi) from aquatic breeding habitat to upland aestivation habitat.

Current factors associated with declining tiger salamander populations include continued habitat loss and degradation due to agriculture and urbanization, hybridization with the nonnative eastern tiger salamander (*Ambystoma tigrinum*) (Fitzpatrick and Shaffer 2004, Riley *et al.* 2003), and predation by introduced species. Tiger salamander populations are likely threatened by multiple factors but continued habitat fragmentation and colonization of non-native salamanders may represent the most significant current threats. Habitat isolation and fragmentation within many watersheds have precluded dispersal between subpopulations and jeopardized the viability of metapopulations. Other threats include predation and competition from introduced exotic species, possible commercial over-utilization, diseases, various chemical contaminants, road kill, and certain unrestrictive mosquito and rodent control operations.

The only portion of the 2008 Amendment action area in which California tiger salamanders have been recorded is in the Potrero Hills in the northeastern part of the Suisun Marsh area (CNDDB 2008, LSA Associates 2007). This hilly region is surrounded on the west, south, and east by portions of Suisun Marsh. California tiger salamanders do not typically occur in saline habitats, and the species is thus not expected to breed in brackish or saline diked marshes such as those subject to tidal restoration as part of the 2008 Amendment conservation actions. The CDFG (2005) considered it absent from the Hill Slough West Tidal Restoration project area, and although the Hill Slough West project area may be within dispersal distance of potential breeding habitat in the Potrero Hills, tidal marsh and brackish sloughs separating the two areas would preclude dispersal of tiger salamanders to Hill Slough West. The Meins Landing Tidal Restoration project area is not within dispersal distance of the tiger salamander population in the Potrero Hills, and the species is thus absent from Meins Landing as well. However, because California tiger salamanders have been recorded dispersing a mile or more from breeding ponds, there is some potential for tiger salamanders breeding in temporary, freshwater pools within the Potrero Hills to disperse into the upland edges of diked marshes or other areas that could be subject to future tidal restoration.

California tiger salamanders have also been recorded breeding immediately outside the action area in the Jepson Prairie area. Although 2008 Amendment actions will not directly affect the Jepson Prairie, there is some potential for tiger salamanders breeding in the Jepson Prairie to disperse eastward into the margins of areas that could be subject to restoration in the westernmost portion of the Cache Slough Complex.

Critical habitat for the California tiger salamander has been designated, and critical habitat unit 2 of the Central Valley Region is present in the Jepson Prairie area, west of the action area. No 2008 Amendment conservation actions will occur within this critical habitat unit.

California Red-legged Frog

The California red-legged frog (*Rana draytonii*) was listed as federally threatened on 23 May 1996 (USFWS 1996). Critical habitat was designated in 2006 (USFWS 2006c).

According to the listing notice (USFWS 1996) and critical habitat designation (USFWS 2006c), the California red-legged frog is the largest native frog in California, with adults obtaining a length of 3.4-5.4 in (85-138 mm) from the tip of the snout to the rear of the vent (Jennings and Hayes 1994). Adult California red-legged frogs have been observed to breed from late November through early May after the onset of warm rains (Storer 1925, Jennings and Hayes 1994), although red-legged frogs in Alameda County were found to breed from late January though March during the 1990s (Mark Jennings, unpubl. data). Females attach eggs in a single cluster to a vegetation brace just under the surface of the water. The eggs hatch in just over a week and the resulting larvae feed on plant and animal material on the bottom of the pond. It takes at least 4 months for the larvae to metamorphose into juvenile frogs. Most larvae metamorphose into juvenile frogs (at 25-30 mm total length) between July and September, although there are scattered observations of overwintering larvae in perennial ponds such as at the arboretum at Golden Gate Park in San Francisco (Mark Jennings, unpubl. data).

California red-legged frogs have been recorded dispersing more than 2 miles between aquatic habitats (Bulger et al. 2003). Typically, however, red-legged frog dispersal distances are much shorter. Dispersal usually occurs within creek drainages, but movements of more than 1.6 km (1 mi) over upland habitats have been reported during winter (wet) months (USFWS 2006b). Red-legged frogs are often found in summer months in summer foraging habitat that would not be suitable for breeding; these individuals presumably move seasonally between summer foraging habitat and winter breeding habitat.

California red-legged frogs have been observed in a number of aquatic and terrestrial habitats throughout their historic range. Larvae, juveniles, and adult frogs have been collected from natural lagoons, dune ponds, pools in or next to streams, streams, marshlands, sag ponds, and springs, as well as human-created stock ponds, secondary and tertiary sewage treatment ponds, wells, canals, golf course ponds, irrigation ponds, sand and gravel pits (containing water), and large reservoirs (Jennings 1988). The key to the presence of frogs in these habitats is the presence of perennial (or near perennial) water and the general lack of introduced aquatic predators such as centrarchid fishes (*e.g.*, largemouth bass [*Micropterus salmoides*], green sunfish [*Lepomis cyanellus*], and bluegill), crayfish (*Pacifastacus leniusculus* and *Procambarus clarkii*), and bullfrogs. As long as there is standing water at least several in deep, and introduced aquatic predators are rare or nonexistent, conditions are at least potentially suitable for red-legged frogs. If the aquatic habitat favors introduced aquatic predators, then red-legged frogs will probably disappear over time unless there is a nearby breeding site available that excludes introduced predators. The habitats that contain the highest densities of red-legged frogs are associated with deep-water pools (27 in [>0.7 m] deep) with stands of overhanging willows (*Salix* spp.) and an intermixed fringe of cattails (*Typha latifolia*), tules (*Scirpus* spp.), or sedges (*Carex* spp.) (Hayes and Jennings 1988). However, California red-legged frogs have also been observed to inhabit stock ponds, sewage treatment ponds, and artificial (*i.e.*, concrete) pools completely devoid of vegetation (Storer 1925; Mark Jennings, unpubl. data). Continued survival of frogs in all aquatic habitats seems to be based on the continued presence of ponds, springs, or pools that are disjunct from perennial streams. Such habitats provide the continued basis for successful reproduction and recruitment year after year into nearby drainages that may lose frog populations due to stochastic events such as extreme flooding or droughts.

In addition to the aquatic habitats, juvenile and adult California red-legged frogs have been observed in areas of riparian vegetation, usually within a few meters of the water's edge. Frogs have been found utilizing small mammal burrows (often in or under vegetation), willow root wads, and hiding under old boards and other debris within the riparian zone (Mark Jennings, unpubl. data). Juvenile frogs are often observed sunning themselves during the day in the warm, surface-water layer associated with floating and submerged vegetation (Hayes and Tennant 1985). Adult frogs are largely nocturnal and are known to sit on stream banks or on the low hanging limbs of willow trees over pools of water where they can detect small mammal prey (Hayes and Tennant 1985, Jennings and Hayes 1994).

Radio-telemetry studies conducted in lagoons and the lower portions of streams along the Central Coast of California show that adult red-legged frogs will move within the riparian zone from well-vegetated areas to pools of water to hydrate during periods of time when many of the Central Coast streams are dry except for isolated pools (Rathbun *et al.* 1993). During wet periods (especially in the winter and early spring months), red-legged frogs can move long

distances (*e.g.*, 1 mi) between aquatic habitats, often over areas that are considered to be unsuitable for frogs (*e.g.*, roads, open fields, croplands, etc.). Such activities can result in frogs ending up in isolated aquatic habitats well away from the nearest known frog populations. Such movement over upland areas is best documented in mesic coastal areas.

Although the species formerly ranged throughout much of the Central Valley from Redding (Shasta County) south and along the coast from Marin County southward, it has disappeared from approximately 70% of its former range, including most of the Central Valley floor (USFWS 2002). Reasons for these declines include loss and degradation of habitat as a result of development, urbanization, recreation, invasion of nonnative plants, diversion and impoundment of water, water quality degradation, and introduction of nonnative predators (USFWS 2002, 2006c).

Actions specified by the recovery plan (USFWS 2002) to recover the species include:

- Protect known populations and reestablish populations.
- Protect suitable habitat, corridors, and core areas.
- Develop and implement management plans for preserved habitat, occupied watersheds, and core areas.
- Develop land use guidelines.
- Gather biological and ecological data necessary for conservation of the species.
- Monitor existing populations and conduct surveys for new populations.
- Establish an outreach program.

Within the 2008 Amendment action area, the only location where this species may still occur is in the Suisun Marsh area. The area immediately west of the Suisun Marsh, separated from the Marsh by Interstate 680, is considered a "core area" for the species in the 2002 recovery plan (USFWS 2002) and has been designated as critical habitat for the species (USFWS 2006c).

Throughout most of their range, California red-legged frogs are associated with freshwater habitats. However, this species does occur in brackish coastal lagoons (USFWS 2006c), and the less saline portions of Suisun Marsh could support this species. The USFWS (2002) recovery plan for the species notes that there are three records near Suisun Marsh, but there are no CNDDB records of the species from areas of Suisun Marsh suitable for tidal restoration pursuant to the 2008 Amendment. California red-legged frogs were considered absent from the Hill Slough West Tidal Restoration project area by the CDFG (2005). Because the Meins Landing Tidal Restoration project area is even closer to Suisun Bay (and thus farther from potential source populations in hills west of Suisun Marsh), red-legged frogs are not expected to occur at Meins Landing. The northern and eastern portions of the Suisun Marsh are highly unlikely to support red-legged frogs, since they are far from potential source populations in the hills west of the marsh, and since they are separated from those source populations by extensive areas of diked marsh that provide poor habitat for the species. The only potential tidal restoration areas

in Suisun Marsh where there is a reasonable potential for occurrence by red-legged frogs is along the western edge of the marsh.

Critical habitat for the California red-legged frog has been designated (USFWS 2006c), and critical habitat unit SOL-1 is present in the hills immediately west of the Suisun Marsh. However, this critical habitat unit is separated from Suisun Marsh by Interstate 680, and no 2008 Amendment conservation actions will occur within the critical habitat unit.

Giant Garter Snake

The giant garter snake (*Thamnophis gigas*) was federally listed as threatened in 1993 (USFWS 1993a).

According to the listing rule (USFWS 1993a) and the draft recovery plan (USFWS 1999), the giant garter snake is an aquatic snake endemic to the Central Valley of California. They are associated with low gradient streams and sloughs as well as valley floor wetlands and marshes, and they are frequently found in regions with rice agriculture. Giant garter snakes are one of the largest snakes in the genus *Thamnophis.*

The species is relatively inactive during the winter, typically overwintering in burrows and crevices near active season foraging habitat. Individuals have been noted using burrows as far as 164 ft from marsh edges during the active season, and retreating as far as 820 ft from the edge of wetland habitats while overwintering, presumably to reach hibernacula above the annual high water mark (Hansen 1986, Wylie *et al.* 1997, USFWS 1999). After emerging from overwintering sites, male giant garter snakes immediately disperse in search of mates and will continue breeding from March into early May. Female giant garter snakes brood young internally, giving birth to live young from late July through early September (Hansen and Hansen 1990).

Connectivity between regions is important for providing access to available habitat and for genetic interchange. In the agricultural matrix of the Central Valley floor, giant garter snakes rely largely upon the network of canals and ditches that provide irrigation and drainage to provide this connectivity.

Giant garter snakes are generally found in aquatic habitats with the following characteristics:

- Enough water during the snake's active season (typically early spring through mid-fall) to provide cover and food such as small fish and amphibians
- Emergent, herbaceous wetland vegetation, such as cattails (*Typha* spp.) and bulrushes (*Schoenoplectus* spp.)
- Vegetated banks for basking and foraging habitat and escape cover during the active season
- Upland refugia (*e.g.*, bankside burrows, holes, and crevices) near aquatic habitat during the active season

- High ground or upland habitat above the annual high water mark to provide cover and refuge from flood waters during winter (Hansen and Brode 1980).

Currently, the giant garter snake is known to occur from the vicinity of Chico in Butte County south to Mendota Wildlife Area in Fresno County. Giant garter snakes now appear to be most abundant in areas dominated by rice agriculture in the northern Sacramento Valley (USFWS 1993a, 1999, CNDDB 2008).

Giant garter snake distribution has diminished due to loss of wetlands and habitat connectivity resulting from agricultural and urban development. The conversion of Central Valley wetlands for agriculture and urban uses has resulted in the loss of as much as 95 percent of historical habitat for the giant garter snake (Wylie *et al.* 1997). Poorly managed grazing, loss of cover in wetlands and along streams, and predation by non-native and urban-adaptive species have also impacted this species.

Evidence that giant garter snakes may have once been distributed throughout the easterly reaches of Yolo County is illustrated by sightings in portions of Solano County adjacent to Yolo County in South Fork Putah Creek near Davis and the western Cache Slough Complex region of the Yolo Basin.

According to the draft recovery plan (USFWS 1999), proposed recovery actions include:

- Protecting existing populations and habitat
- Restoring populations to former habitat
- Conducting surveys to determine the distribution of the species
- Monitoring populations
- Conducting necessary research, including studies on demographics, population genetics, and habitat use
- Developing and implementing incentive programs and an outreach and education plan.

There are few records of the giant garter snake in Solano County, all of which were in the eastern part of the county. One was recorded in 1987 in a canal crossing Swan Road, north of the western Cache Slough Complex and west of the Yolo Bypass, and the species was observed in 1987 and 1994 along Liberty Island Road, 1.3 miles south of Swan Road (CNDDB 2008); these areas are just west of the 2008 Amendment action area. Occurrence in the Cache Slough area of Solano County is uncertain; a focused trapping survey at 17 locations in eastern Solano County in 2004 and 2005 failed to detect the species (Wylie and Martin 2005).

The species is known to occur in the 2008 Amendment action area in the Yolo Bypass, where it was recorded in the northern part of the Bypass in 1985 and 1999, and in the Vic Fazio Wildlife Area just south of Interstate 80 in 2004 (CNDDB 2008).

Based on CNDDB (2008) records and those summarized in USFWS (1999), as well as the extent of the species former range and the species' recovery units, the potential 2008 Amendment conservation projects that may occur within the range of the species are presumed to include:

- Aquatic habitat restoration projects in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex
- Activities to enhance fish habitat and passage in the Yolo Bypass, including the Lower Putah Creek realignment, Lisbon weir improvements, additional multi-species floodplain habitat development improvements, Tule Canal conductivity improvements, and Fremont Weir fish passage improvements
- The Deer Creek Flow Conservation Program
- The Mill Creek Water Exchange Program and Mill Creek Water Right Opportunities project
- The Parrott Phelan and Durham Mutual Dam fish ladder and screen maintenance project

California Clapper Rail

The California clapper rail (*Rallus longirostris obsoletus*) was federally listed as endangered in 1970 (USFWS 1970). California clapper rails are typically found in the intertidal zone and sloughs of salt and brackish marshes dominated by pickleweed, Pacific cordgrass (*Spartina foliosa*), gumplant (*Grindelia stricta* var. *angustifolia*), saltgrass, and jaumea with adjacent upland transition zone refugia. They may also occupy habitats with other vegetative components, which include, but are not limited to, bulrush, cattails, and Baltic rush.

The clapper rail breeding season, including pair bonding and nest construction, may begin as early as February (Evens and Page 1983). The end of the breeding season is typically defined as the end of August, which corresponds with the time when eggs laid during renesting attempts have hatched and young are mobile. The clapper rail typically feeds on benthic invertebrates, but its diet is wide-ranging and includes seeds and occasionally small mammals such as the salt marsh harvest mouse.

The California clapper rail is endemic to tidally influenced salt and brackish marshes of California. Historically, this species occurred in tidal marshes along California's coast from Morro Bay in San Luis Obispo County, to Humboldt Bay in Humboldt County. Currently, clapper rails are known to occur in tidal marshes in the San Francisco Estuary (San Francisco, San Pablo, Grizzly, Suisun and Honker Bays).

In the North Bay, clapper rails inhabit tidal brackish marshes that vary significantly in vegetation structure and composition. The rails' use of these marshes is restricted to major sloughs and rivers of San Pablo Bay and Suisun Marsh. Their distribution in the North Bay is patchy and discontinuous, and rails occur primarily in small, isolated habitat fragments. Small populations of rails are widely distributed throughout the San Pablo Bay, and they are present in low

numbers, with patchy distribution, throughout the Suisun Marsh area in Contra Costa and Solano Counties (CNDDB 2008).

An estimated 40,191 ac of tidal marshes remained in 1988 of the 189,931 ac. of tidal marsh that historically occurred in the San Francicso Bay Estuary; this represents a 79% reduction from historical conditions (Goals Project 1999). The introduction of non-native, invasive plant species such as smooth cordgrass (*S. alterniflora*) and its hybrids into tidal wetlands within the San Francisco Bay Estuary is potentially impacting clapper rails by reducing the amount of foraging habitat within tidal channels. The suitability of many marshes for clapper rails is further limited, and in some cases precluded, by their small size, fragmentation, and lack of tidal channel systems and other micro-habitat features. These limitations render much of the remaining tidal marsh acreage unsuitable or of low value for the species. A recovery plan for the California clapper rail and the salt marsh harvest mouse (USFWS 1984b) has been prepared, but the USFWS is in the process of revising it.

Although Gill (1978) may have overestimated the total clapper rail population in the mid-1970s at 4200 to 5900 birds, surveys conducted by the CDFG and the USFWS estimated that the clapper rail population approximated 1,500 birds in the mid-1980s (Harvey 1988). A conservative estimate of the population in north San Francisco, San Pablo, and Suisun Bays was 195 to 282 pairs based on a synoptic survey conducted in 1992-93 (Collins *et al.* 1994).

The clapper rail was listed as endangered primarily as a result of habitat loss. The factors described above have contributed to the more recent population reduction, which has occurred since the mid-1980s. Although many factors are at work, predation by native and non-native predators, in conjunction with historic habitat loss and fragmentation, are the current known primary threats. Mercury accumulation in eggs is perhaps the most significant contaminant problem affecting clapper rails in the San Francisco Bay Estuary (Schwarzbach *et al.* 2006). Disturbance during the nonbreeding season may affect survival of adult and subadult rails. Human-related disturbance of clapper rails in the winter, particularly during high tide and storm events, may also increase the birds' vulnerability to predators.

In the vicinity of the 2008 Amendment action area, California clapper rails occur only within the Suisun Marsh. Their distribution throughout Suisun Marsh is sparse and patchy, largely due to the paucity of extensive, fully tidal marshes and the low habitat quality provided by narrow fringe marshes along channels. The occurrence of this species in the Suisun Marsh may also be sporadic, with birds present in some years but not others (Albertson and Evens 2000). However clapper rails have been recorded in a number of areas along tidal channels within the marsh, and they likely occur, at least occasionally, in channels near the Hill Slough West Tidal Marsh Restoration and Meins Landing Tidal Marsh Restoration areas.

Western Snowy Plover

The western snowy plover (*Charadrius alexandrinus nivosus*) is a small pale shorebird that nests on beaches and salt pans in western North America. The USFWS listed the coastal population of the western snowy plover as a threatened species in 1993 (USFWS 1993b) because of a decline in the breeding population, loss of breeding habitat, and increased depredation by non-native

predators. Critical habitat for the western snowy plover was designated in 2005 (USFWS 2005c). A recovery plan was issued in 2007 that contains additional information on the biology and ecology of this species (USFWS 2007e).

On the Pacific coast, snowy plovers nest on sandy beaches and salt pan habitat from Washington to Baja Mexico. Because they nest during the summer, primarily on beaches in a temperate climate, western snowy plovers are susceptible to nest disturbance and other negative interactions with humans. Much of their nesting habitat, particularly in southern California, has been lost to development and high human use. In addition, introduced predators, especially the non-native red fox, have had dramatic effects on snowy plover nesting success (Neuman and others 2004).

In the San Francisco Bay, snowy plovers occur primarily in the South Bay, mostly south of the San Mateo Bridge. Here, snowy plovers nest on low, barren to sparsely vegetated salt pond levees and islands, at pond edges, and on salt pan areas of dry ponds (Page et al. 2000), and preferentially use light-colored substrates such as salt flats (Feeney and Maffei 1991, Marriott 2003). Nesting areas are located near water, where prey (usually brine flies and other insects) are abundant. In some areas, snowy plovers nest within dry salt ponds; in other areas where ponds typically hold water through the summer (e.g., the Newark salt ponds), nests are located primarily on levees. Often, nests are located near disruptive objects such as rocks or surface irregularities and may be constructed in depressions created by footprints and vehicles (Marriott 2003, Page et al. 1995). Nests consist of a depression scratched into the substrate sometimes lined with shell fragments, pebbles, or similar local materials (Page et al. 1995, 2000).

According to Page et al. (1995), pairing begins as early as mid February; egg-laying commences in early March and may continue with multiple broods into early August. The incubation period ranges from 26 to 32 days. Three eggs are typically laid two to five days apart. Replacement clutches are initiated approximately six to eight days after the destruction of a completed clutch. Young birds are precocial, leaving the nest within hours of hatching. Chicks are usually cared for exclusively by the male parent, until they fledge at 28 to 33 days. Chicks feed themselves, but require the protection of an adult for brooding and evasion of predators. The breeding season of the western snowy plover in California, from nest initiation to fledging of chicks, is considered to be March 1 to September 31. Although snowy plovers can nest as early as March 1, damp nesting substrate in salt ponds, from flooding or normal spring rains, may delay nesting in this habitat until the substrate dries.

Snowy plovers in San Francisco Bay forage primarily on small flies, especially brine flies (Ephydra cinerea and Lipochaeta slossonae) (Feeney and Maffei 1991). They also feed on other small invertebrates, including beetles and small marine invertebrates. Snowy plovers forage visually and often run after prey which they capture in their bills. Brine flies are usually found in greatest densities at the shallow margins of shallow salt ponds or puddles, but snowy plovers also forage in open salt flats, and occasionally, on mudflats adjacent to salt ponds.

According to the recovery plan (USFWS 2007), proposed recovery actions include:

- Monitoring and managing breeding habitat to maximize survival and productivity

- Monitoring and managing wintering and migration areas to maximize snowy plover population survival
- Developing mechanisms for long-term management and protection of snowy plovers and their breeding and wintering habitat
- Undertaking scientific investigations that facilitate recovery efforts
- Undertaking public information and education programs
- Reviewing progress toward recovery annually and revising recovery efforts as appropriate
- Dedicating USFWS staff and funding for the Sacramento Fish and Wildlife Office to coordinate recovery implementation
- Establishing an international conservation program with the government of Mexico to protect snowy plovers and their breeding and wintering locations in Mexico

Within San Francisco Bay, most plovers breed in the South Bay. Elsewhere, a few pairs in Napa salt ponds represented the only breeders in the North Bay area until breeding snowy plovers were discovered in 2006 at the Montezuma Wetlands project area on the east side of Montezuma Slough near Birds Landing (Napa-Solano Audubon Society 2006). At the Montezuma Wetlands project, breeding snowy plovers were observed using extensive bare areas created by the disposal of dredged materials that were being used to raise the elevation of the marsh prior to tidal restoration. This location, which is in the Suisun Marsh, is the only location in the 2008 Amendment action area where western snowy plovers are known to breed. The Hill Slough West Tidal Restoration project area is located several miles to the northwest of the Montezuma Wetlands project breeding area, and does not provide suitable nesting habitat for snowy plovers. Although the Meins Landing Tidal Restoration project area is located immediately to the northwest of the Montezuma Wetlands, it also lacks nesting habitat for this species due to the vegetated nature of the site. Because snowy plovers are opportunistic breeders, capable of moving around among potential breeding areas and breeding where conditions are suitable, it is possible that future restoration elsewhere in the Suisun Marsh pursuant to the 2008 Amendment may occur near occupied snowy plover breeding areas.

California Least Tern

The California least tern (*Sternula antillarum browni*) was listed as federally endangered on 13 October 1970 (USFWS 1970). Least terns are small fish-eating birds that nest primarily on beaches. The California least tern breeds from Baja California north to San Francisco Bay. Least terns are migratory and spend winter months in coastal areas of Mexico and Central America. Most breeding colonies are located in southern California.

In San Francisco Bay, the main colony is located on an old airport runway at the Alameda National Wildlife Refuge near Oakland. This colony is one of the most important breeding colonies in the state and as of 2004 was the only nesting colony in San Francisco Bay. In 2003, this colony had 301 breeding pairs (Hurt, pers. comm.). This total is up considerably from prior decades: 128 pairs were found in 1993, and only 70 pairs nested in 1982 (Collins 1994). Least terns nesting at Alameda typically arrive at the colony in late April and fledge chicks from late June to early August. They forage for small fish in shallow coastal waters near the colony, mainly around Alameda Point (Hurt 2004). Adults and juveniles typically start dispersing south from the Alameda colony in early July.

Least terns also nested in 2000 and 2001 at Albany (near Alameda), with up to 12 pairs in 2000. At Pittsburg, on Suisun Bay, 13 pairs nested in 2001 and 8 pairs nested in 2003. Historically, small numbers of birds have nested at the Oakland International Airport (last reported in 1995), Bay Farm Island (last reported 1975), Bair Island (last reported 1984), Port Chicago (last reported in 1988), the Bay Bridge Sand Spit (one-time attempt in 1985), and Tern Island (one-time attempt in 1990). A few nesting attempts have occurred in South Bay salt ponds as well.

The major cause of breeding failure at many least tern colony sites in California has been documented as predation on eggs, chicks, fledglings, and adults (Caffrey 1995). A wide variety of predators has been documented to prey upon least terns, including most gull species and 22 other avian species, 14 mammalian species, and some species of snakes, crabs, ants, and spiders (Caffrey 1995). In addition to direct loss or mortality of eggs and individuals, avian and mammalian predators can cause least tern adults to abandon breeding sites prior to completion of nesting activities. A recovery plan for the species was prepared in 1985 (USFWS 1985), but it is now considered outdated (USFWS 2006a).

The California least tern was not known to nest in the 2008 Amendment action area until 2006, when a colony of 17-24 pairs was discovered at the Montezuma Wetlands project area on the east side of Montezuma Slough near Birds Landing (Napa-Solano Audubon Society 2006, Shuford undated). Like the snowy plovers observed at the same time and location, these terns were observed using extensive bare areas created by the disposal of dredged materials that were being used to raise the elevation of the marsh prior to tidal restoration. The Hill Slough West Tidal Restoration project area is located several miles to the northwest of the Montezuma Wetlands project breeding area, and does not provide suitable nesting habitat for snowy plovers. Although the Meins Landing Tidal Restoration project area is located immediately to the northwest of the Montezuma Wetlands, it also lacks nesting habitat for this species due to the vegetated nature of the site.

Salt Marsh Harvest Mouse

The salt marsh harvest mouse (*Reithrodontomys raviventris*) was listed as federally endangered in 1970 (USFWS 1970). The salt marsh harvest mouse is a rodent endemic to the salt and brackish marshes of the San Francisco Estuary and adjacent tidally influenced areas. As described by Fisler (1965), male harvest mice are reproductively active from April through

September, but may appear active throughout the year. Females are reproductively active from March to November and have a mean litter size of approximately four offspring.

The harvest mouse has evolved to a life in tidal marshes. They depend mainly on dense pickleweed as their primary cover and food source and may utilize a broader source of food and cover that includes saltgrass and other vegetation typically found in the salt and brackish marshes of these regions. Historically, the marshes in San Francisco Bay were a complex mosaic of vegetation zones, generally consisting of low marsh adjacent to mudflats dominated by cordgrass, high marsh plains dominated by pickleweed, and broad transitions of peripheral halophytes (salt-tolerant plants that cannot tolerate as much inundation by the tides) into upland habitats, with narrower transitional zones on natural levees along larger channels within the marshes. Most of the tidal marshes around the Bay were eliminated, and those remaining have lost the upper portion of their pickleweed zones as well as the higher zone of peripheral halophytes (Shellhammer 1982, Shellhammer and Duke 2004).

In natural systems, harvest mice can be found in the middle tidal marsh and upland transition zones. Upland refugia are an essential habitat component during high tide events. Harvest mice are highly dependent on cover, and open areas as small as 33 ft wide may act as barriers to movement (Shellhammer 1978, as cited in USFWS 1984b). The harvest mouse does not burrow. It has been noted that the northern subspecies may build nests of loose grasses.

Cover-dependent salt marsh harvest mice are unlikely to move long distances over bare areas, and thus, isolation of suitable habitat may lead to genetic isolation of populations. While they are known to swim well, especially in comparison with western harvest mice, they have not been documented to move more than 13.1 to 16.4 ft across water or more than 16.4 ft over bare ground (Bias 1994, Geissel *et al.* 1988). The maximum movement through brackish or fresh water vegetation is reported in H.T. Harvey & Associates (Shellhammer 1982), in which two salt marsh harvest mice moved several hundred feet along a levee side-slope at the upper edge of a brackish marsh. Based on this information, Shellhammer and Duke (2004) have hypothesized that barren areas of land more than 16.4 ft wide, reaches of water more than 42 ft wide, and brackish or freshwater marsh more than 820 ft wide act as barriers to movement of the southern subspecies of the salt marsh harvest mouse, and hence barriers to gene flow. Areas of bare ground, water, or fresh/brackish marsh less than or equal to these distances may act as filters, reducing the movement of animals (and hence the rate of gene flow) between populations or between portions of a semi-fragmented population. The isolation of populations has contributed to the decline of the species (Shellhammer and Duke 2004) and could lead to local extinctions due to demographic processes or genetic “death”.

The historic range of the species included tidal marshes within the San Francisco and San Pablo Bays, east to the Collinsville-Antioch areas. Agriculture and urbanization has claimed much of the former historic tidal marshes, resulting in a 79% reduction in the amount of tidal marshes in these areas (Goals Project 1999). At present, the distribution of the northern subspecies occurs along Suisun and San Pablo Bays north of Point Pinole in Contra Costa County, and Point Pedro in Marin County. The southern subspecies is found in marshes in Corte Madera, Richmond, and South San Francisco Bay mostly south of the San Mateo Bridge (Highway 92).

Habitat degradation has also occurred as a result of the conversion of existing tidal salt marsh to brackish or even freshwater marsh over the past four decades. As a result of habitat loss, degradation, and fragmentation, salt marsh harvest mouse populations are low. Despite the species' low populations, the salt marsh harvest mouse is known to rapidly colonize restored areas. This species quickly moves into areas of appropriate habitat from nearby inhabited areas as has been shown in numerous trapping projects' reports. A recovery plan for the California clapper rail and the salt marsh harvest mouse (USFWS 1984) has been prepared, but the USFWS is in the process of revising it.

In the vicinity of the 2008 Amendment action area, salt marsh harvest mice are present throughout the Suisun Marsh area, with numerous extant records of the species occurring in the intertidal zones (CNDDB 2008). The species is known to occur at the Hill Slough West Tidal Marsh Restoration project area (CDFG 2005), and pickleweed habitat is present at the Meins Landing Tidal Restoration project area (California Coastal Conservancy 2004), likely supporting salt marsh harvest mice.

Delta Fish Agreement 2008 Amendment- Effects of the Proposed Programmatic Action

Effects of the action are defined in 50 CFR §402.02 as "the direct and indirect effects of an action on the species, together with the effects of other activities that are interrelated or interdependent with the action, that will be added to the environmental baseline." Direct effects occur at the project site and may extend upstream or downstream based on the potential for impairing important habitat elements. Indirect effects are defined as “those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.” They include the effects on listed species of future activities that are induced by the proposed action and that occur after the action is completed. Interrelated actions are “those that are part of a larger action and depend on the larger action for their justification.” Interdependent actions are “those that have no independent utility apart from the action under consideration.” Cumulative effects, which are discussed separately after this section, are the effects of future State, local, or private activities, not involving Federal activities that are reasonably certain to occur in the action area.

The most significant effects of the Delta Fish Agreement 2008 Amendment (hereafter 2008 Amendment) conservation actions on the listed fish species, including delta smelt, longfin smelt, Sacramento River winter-run Chinook salmon (hereafter “winter-run Chinook Salmon”), Central Valley spring-run Chinook salmon (hereafter “spring-run Chinook salmon”), California Central Valley steelhead, Central California Coast steelhead, and green sturgeon, will be substantial habitat enhancements resulting from habitat restoration and other activities that are specifically focused on increasing habitat, enhancing habitat conditions, improving access to habitat, and protecting individual fish. Other listed species, including the soft bird’s-beak, Suisun thistle, giant garter snake, California clapper rail, and salt marsh harvest mouse, and possibly also the valley elderberry longhorn beetle, will also benefit from proposed habitat restoration activities under the 2008 Amendment. In the effects analyses that follow, both the potential minor, short-term adverse effects and the more substantial, long-term beneficial effects on these species are discussed programmatically.

Several other listed species, including Hoover’s spurge, hairy Orcutt grass, slender Orcutt grass, Greene’s tuctoria, Colusa grass, Solano grass, Contra Costa goldfields, Conservancy fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, California tiger salamander, California red-legged frog, western snowy plover, and California least tern, could occur in or near the locations of 2008 Amendment conservation actions. Because habitat restored for the target fish species may not be consistent with habitat for these other species, there is some potential for these actions to result in adverse effects on these species. However, as discussed for each species below, BMPs will be implemented to avoid and minimize effects, as will be described in the project-specific biological assessments that are prepared for individual projects.

Effects on Soft Bird's-beak

Soft bird's-beak occurs in widely scattered populations around San Pablo Bay and Suisun Bay from Point Pinole and Fagan Slough Marsh through the Carquinez Strait to Suisun Bay in Napa, Solano, and Contra Costa Counties. In the 2008 Amendment action area, soft bird's-beak occurs only in the Suisun Marsh, where there are a number of scattered occurrence records. This species typically occurs in fully tidal marshes, and although it can occur in muted tidal marshes it "does not readily occur" in diked wetlands (USFWS 2007d). The potential 2008 Amendment conservation actions in the Suisun Marsh, such as the Hill Slough West Tidal Marsh Restoration project and Meins Landing Tidal Restoration project, will target the restoration of tidal action to diked areas. The CDFG (2005) determined that this species could potentially occur in the Hill Slough West Tidal Restoration project action area and identified measures to avoid and minimize impacts to the species if it is present. Given the presence of records from the Suisun Marsh, the species could potentially be present in the Meins Landing project area as well. However, neither of these areas provides high-quality, fully tidal marsh for this species.

These conservation actions could result in adverse effects to only a fraction of the populations of this species, at most, and thus will not jeopardize the continued existence of the species. Furthermore, actions involving tidal marsh restoration in the Suisun Marsh would enhance habitat for this species, thus having a net benefit to soft bird's-beak and helping to contribute to the species' recovery.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for this species, and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating).

Potential effects of the 2008 Amendment actions on soft bird's-beak and its designated critical habitat are described below.

Habitat Modification

Soft bird's-beak occurs in upper regions of tidal marshes. Projects implemented in the vicinity of populations of this species pursuant to the 2008 Amendment will be Suisun Marsh tidal marsh restoration projects. Modification of habitat for this species could occur in several ways. Small-scale, localized loss of habitat for the soft bird's-beak could result from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, flooding following breaching of levees, and other project-related activities. At any one location, the extent of habitat to be impacted will be very small compared to the suitable habitat for the species that will be restored, however. Alteration of the hydrologic regime supporting existing habitat could also occur, with areas now at upper edges of the marsh being subjected to more frequent and/or longer duration tidal inundation. In addition, where soft bird's-beak habitat is present inside a diked marsh to be restored to tidal action, habitat for this species could be lost due to flooding, at least until sedimentation has elevated the restored marshplain to suitable elevations for colonization by this species.

Some habitat for this species could be lost due to the scour of existing marsh, which may result from an increase in tidal prism after tidal action is restored to diked marshes. However, soft bird's-beak is typically not found in narrow fringe-marsh zones (USFWS 1997), and this short-term loss of habitat from fringe marsh scour will be more than offset by the development of additional tidal marsh habitat in restored marshes.

Because conservation actions in and near habitat for this species will consist of tidal restoration projects, the net effect of such projects on soft bird's-beak habitat will be beneficial. Overall habitat quality and extent in these areas will increase as restoration creates larger marshes with more suitable upper marsh ecotone habitat. Furthermore, BMPs will be implemented to avoid and minimize adverse direct and indirect effects to occupied areas (see *Best Management Practices* above), minimizing the likelihood that occupied habitat will be impacted.

Loss of Individuals

Without implementation of appropriate BMPs, there are several ways in which conservation actions could potentially result in loss of individuals. Individuals could be destroyed as a result of grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, trampling by vehicles accessing construction or monitoring areas, flooding following breaching of levees or other changes in currently suitable hydrologic regimes, and other project-related activities. There is also potential for dust generated during construction to adversely affect individuals by coating leaves, flowers, and seeds, which could harm individuals by restricting normal gas exchange and photosynthetic pathways, and which could reduce fecundity. Projects may also adversely affect the non-listed hosts of this hemiparasitic plant, causing indirect adverse effects on individuals. However, BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above), minimizing the likelihood of such impacts.

Effects on Soft Bird's Beak Critical Habitat

Soft bird's-beak critical habitat has been designated in the Suisun Marsh (USFWS 2007d). Although the Hill Slough West and Meins Landing tidal marsh restoration projects are not within designated critical habitat, it is possible that other future tidal restoration projects implemented pursuant to the 2008 Amendment could occur in or very close to designated critical habitat for this species. The primary constituent elements (PCEs) of designated critical habitat for soft bird's-beak are:

- Persistent emergent, intertidal, estuarine wetland at or above the mean high-water line (as extended directly across any intersecting channels);
- Rarity or absence of plants that naturally die in late spring (winter annuals);
- Partially open spring canopy cover (approximately 790 nMol/m2/s) at ground level, with many small openings to facilitate seedling germination.

These PCEs are not present in diked wetlands that are currently present in areas that would be restored in Suisun Marsh, such as at Hill Slough West and Meins Landing, and thus the project will not adversely modify the PCEs of soft bird's-beak critical habitat. Rather, the conservation actions in the Suisun Marsh will restore all three of these PCEs when diked marshes are converted to fully tidal marsh, as is proposed for the Hill Slough West and Meins Landing tidal marsh restoration projects. The fully tidal marshes that will be restored are more likely than the existing diked marshes to support suitable hosts for the parasitic soft bird's-beak, such as salt grass (*Distichlis spicata*), pickleweed (*Sarcocornia pacifica*), and marsh jaumea (*Jaumea carnosa*), and more likely to provide openings in the spring canopy for seedling germination. Thus, the 2008 Amendment actions will contribute to this species' recovery.

Effects on Suisun Thistle

Suisun thistle occurs in middle and high tidal marsh ecotones along tidal slough channels in Suisun Marsh. This species typically occurs in fully tidal marshes, and it does not thrive in diked wetlands (USFWS 2007d). The potential 2008 Amendment conservation actions in the Suisun Marsh, such as the Hill Slough West Tidal Marsh Restoration project and Meins Landing Tidal Restoration project, will target the restoration of tidal action to diked areas. The CDFG (2005) determined that this species could potentially occur in the Hill Slough West Tidal Restoration project action area and identified measures to avoid and minimize impacts to the species if it is present. Given the presence of records from the Suisun Marsh, the species could potentially be present in the Meins Landing project area as well. However, neither of these areas provides high-quality, fully tidal marsh for this species.

These projects could result in adverse effects to only a fraction of the populations of this species, at most, and thus will not jeopardize the continued existence of the species. Furthermore, actions involving tidal marsh restoration in the Suisun Marsh would enhance habitat for this species, thus having a net benefit to Suisun thistle and helping to contribute to the species' recovery.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for this species, and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating).

Potential effects of the 2008 Amendment actions on Suisun thistle and its designated critical habitat are described below.

Habitat Modification

The middle and high tidal marsh ecotones along tidal slough channels in which this species occurs are frequent in the Suisun Marsh region. Because this species is associated with tidal channels, and potential conservation actions such as the Hill Slough West and Meins Landing tidal marsh restoration projects will target the restoration of tidal action to diked areas, there is a low probability that occupied habitat will be directly altered by the project. Nevertheless, it is

possible that the species may be present within these specific project areas or in other areas of Suisun Marsh where tidal restoration could potentially occur.

Modification of habitat for this species could occur in several ways. Small-scale, localized loss of habitat for the Suisun thistle could result from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, flooding following breaching of levees, and other project-related activities. At any one location, the extent of habitat to be impacted will be very small compared to the proposed restoration, however. Alteration of the hydrologic regime supporting existing habitat could also occur, with areas now at upper edges of the marsh being subjected to more frequent and/or longer duration tidal inundation. In addition, where Suisun thistle habitat is present inside a diked marsh to be restored to tidal action, habitat for this species could be lost due to flooding, at least until sedimentation has elevated the restored marshplain to suitable elevations for colonization by this species.

Some habitat for this species could be lost due to the scour of existing marsh, which may result from an increase in tidal prism after tidal action is restored to diked marshes. However, Suisun thistle is typically not found in narrow fringe-marsh zones (USFWS 1997), and this short-term loss of habitat from fringe marsh scour will be more than offset by the development of additional tidal marsh habitat along tidal channels in restored marshes.

Because 2008 Amendment conservation actions in and near suitable habitat for this species will consist of tidal restoration projects, the net effect of such projects on Suisun thistle habitat will be beneficial. Overall habitat quality and extent in these areas will increase as restoration creates larger marshes with more suitable upper marsh ecotone habitat. BMPs will be implemented to avoid adverse effects to occupied areas (see *Best Management Practices* above), minimizing the likelihood that suitable habitat will be impacted.

Loss of Individuals

Without implementation of appropriate BMPs, there are several ways in which conservation actions could potentially result in loss of individuals of Suisun thistle. Individuals could be destroyed as a result of grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, trampling by vehicles accessing construction or monitoring areas, and other project-related activities. There is also potential for dust generated during construction to adversely affect individuals by coating leaves, flowers, and seeds, which could harm individuals by restricting normal gas exchange and photosynthetic pathways, and reduce fecundity. However, BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above), minimizing the likelihood of such impacts.

Effects on Suisun Thistle Critical Habitat

Suisun thistle critical habitat has been designated in the Suisun Marsh (USFWS 2007d). Although the Hill Slough West and Meins Landing tidal marsh restoration project areas are not within designated critical habitat, it is possible that other future tidal restoration projects implemented pursuant to the 2008 Amendment could occur in or very close to designated critical habitat for this species. The PCEs of designated critical habitat for Suisun thistle are:

- Persistent emergent, intertidal, estuarine wetland at or above the mean high-water line (as extended directly across any intersecting channels);
- Open channels that periodically contain moving water with ocean derived salts in excess of 0.5 percent;
- Gaps in surrounding vegetation to allow for seed germination and growth.

These PCEs are not present in diked wetlands that would be restored in Suisun Marsh, such as at Hill Slough West and Meins Landing, pursuant to the 2008 Amendments, and thus the project will not adversely modify the PCEs of Suisun thistle critical habitat. Rather, the conservation actions in the Suisun Marsh will restore all three of these PCEs when diked marshes are converted to fully tidal marsh, as is proposed for the Hill Slough West and Meins Landing tidal marsh restoration projects. The fully tidal marshes will provide persistent emergent, intertidal, estuarine wetland with open channels, and are more likely than the existing diked marshes to provide gaps in vegetation to allow for seed germination. Thus, the 2008 Amendment conservation actions will contribute to this species' recovery.

Effects on Hoover's Spurge

Hoover's spurge occurs in typically deep, long-duration, freshwater vernal pools in the northeastern Sacramento Valley, San Joaquin Valley, Solano-Colusa, and Southern Sierra Foothills vernal pool regions. As of 2005, this species was known from more than 30 extant occurrences in Tehama, Butte, Glenn, Stanislaus, Merced, and Tulare Counties (USFWS 2005a). Occurrences of this species in the vicinity of the 2008 Amendment action area are confined to the Vina Plains area of Tehama and Butte Counties. The only 2008 Amendment conservation action that occurs in the vicinity of this species' known populations is the Deer Creek Water Exchange Program in Tehama County, although potential habitat for the species may also be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area. Although the Deer Creek and Mill Creek projects focus primarily on maintaining instream flows by reducing diversions, terrestrial components of these projects' activities include the drilling of groundwater wells (to provide water for agricultural uses that would have otherwise been diverted from Deer and Mill Creeks), operation and maintenance of those wells, surface water monitoring, groundwater monitoring, and fisheries assessment/monitoring.

Hoover's spurge is known from multiple locations, and the terrestrial activities associated with the Deer Creek and Mill Creek projects will be very limited in extent. Thus, these projects could result in adverse effects to only a fraction of the populations of this species, and 2008 Amendment conservation actions would not jeopardize the continued existence of Hoover's spurge. During the project-specific section 7 consultations that will occur for individual projects, the effects of the Deer Creek Water Exchange Program, Mill Creek Water Exchange Program, and Mill Creek Water Right Opportunities project on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described to avoid and minimize adverse effects to this species, and that any residual incidental take will be compensated (*e.g.*, through habitat preservation or restoration).

Potential effects of the 2008 Amendment actions on Hoover's spurge and its designated critical habitat are described below.

Habitat Modification

Because activities associated with the Deer Creek and Mill Creek projects that could occur in habitat for Hoover's spurge are limited, there is a low probability that such activities could modify habitat of this species. Without implementation of appropriate BMPs, adverse effects on habitat could result from changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of well access roads modify runoff patterns. Any grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and other project-related activities could affect vernal pool habitat or runoff patterns in the vicinity of Hoover's spurge habitat. However, BMPs will be implemented to avoid adverse effects to occupied habitat (see *Best Management Practices* above).

Loss of Individuals

Without implementation of appropriate BMPs, adverse effects on individuals could result from changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of well access roads modify runoff patterns, thus reducing the survival and germination of the species. Any grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and other project-related activities could result in trampling of individuals or alteration of conditions for survival and germination of the species. There is also potential for dust generated during project activities to adversely affect individuals by coating leaves, flowers, and seeds which could harm individuals by restricting normal gas exchange and photosynthetic pathways and reduce fecundity. However, BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on Hoover's Spurge Critical Habitat

Hoover's spurge critical habitat has been designated (USFWS 2006a), and critical habitat for the species is present in the 2008 Amendment action area on both sides of Deer Creek in the vicinity of the lower reach which is the focus of the Deer Creek Water Exchange Program (critical habitat unit 1). The PCEs of designated critical habitat for Hoover's spurge are:

- Topographic features characterized by isolated mound and intermound complex within a matrix of surrounding uplands that result in continuously, or intermittently, flowing surface water in the depressional features including swales connecting the pools described below, providing for dispersal and promoting hydroperiods of adequate length in the pools;
- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water or whose soils are saturated for a period long enough to promote germination, flowering, and seed production of predominantly annual native wetland species and typically exclude both native and nonnative upland plant species in all but the driest years. As

these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands.

Without implementation of appropriate BMPs, these PCEs could be adversely affected as described under *Habitat Modification* above. However, BMPs for Hoover's spurge and other vernal pool species will be implemented during 2008 Amendment actions to avoid and minimize adverse effects to designated critical habitat.

Effects on Hairy Orcutt Grass

Hairy Orcutt grass occurs in typically large, long-duration, freshwater vernal pools in Great Central Valley grasslands. As of 2005, this species was known from approximately 27 extant occurrences in Tehama, Butte, Glenn, Stanislaus, and Madera Counties (USFWS 2005a). Occurrences of this species in the vicinity of the 2008 Amendment action area are confined to the Vina Plains area of Tehama and Butte Counties. The only 2008 Amendment conservation action that occurs in the vicinity of this species' known populations is the Deer Creek Water Exchange Program in Tehama County, although potential habitat for the species may also be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area. Although the Deer Creek and Mill Creek projects focus primarily on maintaining instream flows by reducing diversions, terrestrial components of these projects' activities include the drilling of groundwater wells (to provide water for agricultural uses that would have otherwise been diverted from Deer and Mill Creeks), operation and maintenance of those wells, surface water monitoring, groundwater monitoring, and fisheries assessment/monitoring.

Hairy Orcutt grass is known from multiple locations, and the terrestrial activities associated with the Deer Creek and Mill Creek projects will be very limited in extent. Thus, these projects could result in adverse effects to only a fraction of the populations of this species, and 2008 Amendment conservation actions would not jeopardize the continued existence of hairy Orcutt grass. During the project-specific section 7 consultations that will occur for individual projects, the effects of the Deer Creek Water Exchange Program, Mill Creek Water Exchange Program, and Mill Creek Water Right Opportunities project on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described to avoid and minimize adverse effects to this species, and that any residual incidental take will be compensated (*e.g.*, through habitat preservation or restoration).

Potential effects of the 2008 Amendment actions on hairy Orcutt grass and its designated critical habitat are described below.

Habitat Modification

Because activities associated with the Deer Creek Water Exchange Program, Mill Creek Water Exchange Program, and Mill Creek Water Right Opportunities project that could occur in habitat for hairy Orcutt grass are limited, there is a low probability that such activities could modify habitat of this species. Without implementation of appropriate BMPs, adverse effects on habitat

could result from changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of well access roads modify runoff patterns. Any grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and other project-related activities could affect vernal pool habitat or runoff patterns in the vicinity of hairy Orcutt grass habitat. However, BMPs will be implemented to avoid adverse effects to occupied habitat (see *Best Management Practices* above).

Loss of Individuals

Adverse effects on individuals could result from changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of well access roads modify runoff patterns, thus reducing the survival and germination of the species. Any grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and other project-related activities could result in trampling of individuals or alteration of conditions for survival and germination of the species. There is also potential for dust generated during project activities to adversely affect individuals by coating leaves, flowers, and seeds which could harm individuals by restricting normal gas exchange and photosynthetic pathways and reduce fecundity. However, BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on Hairy Orcutt Grass Critical Habitat

Hairy Orcutt grass critical habitat has been designated (USFWS 2006a), and critical habitat for the species is present in the 2008 Amendment action area immediately southeast of Deer Creek in the reach which is the focus of the Deer Creek Water Exchange Program (critical habitat unit 1). The PCEs of designated critical habitat for hairy Orcutt grass are:

- Topographic features characterized by isolated mound and intermound complex within a matrix of surrounding uplands that result in continuously, or intermittently, flowing surface water in the depressional features including swales connecting the pools described below, providing for dispersal and promoting hydroperiods of adequate length in the pools;
- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water or whose soils are saturated for a period long enough to promote germination, flowering, and seed production of predominantly annual native wetland species and typically exclude both native and nonnative upland plant species in all but the driest years. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands.

Without implementation of appropriate BMPs, these PCEs could be adversely affected as described under *Habitat Modification* above. However, BMPs for hairy Orcutt grass and other vernal pool species will be implemented during 2008 Amendment actions to avoid and minimize adverse effects to designated critical habitat.

Effects on Slender Orcutt Grass

Slender Orcutt grass typically occurs in deep, volcanic-substrate vernal pools in Great Central Valley grasslands and northern Sierra foothills regions. As of 2005, this species was known from approximately 76 extant occurrences in nine California counties (USFWS 2005a). Occurrences of this species in the vicinity of the 2008 Amendment action area are confined to the Vina Plains area of Tehama County. The only 2008 Amendment conservation actions that occur in the vicinity of this species' known populations are the Deer Creek Water Exchange Program and Battle Creek Salmon and Steelhead Restoration project in Tehama County, although potential habitat for the species may also be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area. Although the Deer Creek and Mill Creek projects focus primarily on maintaining instream flows by reducing diversions, terrestrial components of these projects' activities include the drilling of groundwater wells (to provide water for agricultural uses that would have otherwise been diverted from Deer and Mill Creeks), operation and maintenance of those wells, surface water monitoring, groundwater monitoring, and fisheries assessment/monitoring. At the Battle Creek project site, because the means to access each component of this project during and after construction, and the details of monitoring, have not yet been identified, there is some potential for Battle Creek project activities to affect slender Orcutt grass.

Slender Orcutt grass is known from multiple locations, and the terrestrial activities associated with the Deer Creek, Mill Creek, and Battle Creek projects will be very limited in extent. Thus, these projects could result in adverse effects to only a fraction of the populations of this species, and 2008 Amendment conservation actions would not jeopardize the continued existence of slender Orcutt grass. During the project-specific section 7 consultations that will occur for individual projects, the effects of these projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described to avoid and minimize adverse effects to this species, and that any residual incidental take will be compensated (*e.g.*, through habitat preservation or restoration).

Potential effects of the 2008 Amendment actions on slender Orcutt grass and its designated critical habitat are described below.

Habitat Modification

Because activities associated with the Deer Creek Water Exchange Program, Mill Creek Water Exchange Program, Mill Creek Water Right Opportunities project, and Battle Creek Salmon and Steelhead Restoration project that could occur in habitat for slender Orcutt grass are limited, there is a low probability that such activities could modify habitat of this species. Without implementation of appropriate BMPs, adverse effects on habitat could result from changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of well access roads modify runoff patterns. Any grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and other project-related activities could affect vernal pool habitat or runoff patterns in the vicinity of slender Orcutt grass habitat. However, BMPs will be implemented to avoid adverse effects to occupied habitat (see *Best Management Practices* above).

Loss of Individuals

Adverse effects on individuals could result from changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of well access roads modify runoff patterns, thus reducing the survival and germination of the species. Any grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and other project-related activities could result in trampling of individuals or alteration of conditions for survival and germination of the species. There is also potential for dust generated during project activities to adversely affect individuals by coating leaves, flowers, and seeds which could harm individuals by restricting normal gas exchange and photosynthetic pathways and reduce fecundity. However, BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on Slender Orcutt Grass Critical Habitat

Slender Orcutt grass critical habitat has been designated (USFWS 2006a), and critical habitat for the species is present in the 2008 Amendment action area in the western portion of the Battle Creek Phase 1 project (Unit 3A) and on both sides of Deer Creek in the vicinity of the lower reach, which is the focus of the Deer Creek Water Exchange Program (critical habitat unit 4). The PCEs of designated critical habitat for slender Orcutt grass are:

- Topographic features characterized by isolated mound and intermound complex within a matrix of surrounding uplands that result in continuously, or intermittently, flowing surface water in the depressional features including swales connecting the pools described below, providing for dispersal and promoting hydroperiods of adequate length in the pools;
- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water or whose soils are saturated for a period long enough to promote germination, flowering, and seed production of predominantly annual native wetland species and typically exclude both native and nonnative upland plant species in all but the driest years. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands.

Without implementation of appropriate BMPs, these PCEs could be adversely affected as described under *Habitat Modification* above. However, BMPs for slender Orcutt grass and other vernal pool species will be implemented during 2008 Amendment actions to avoid and minimize adverse effects to designated critical habitat.

Effects on Greene's Tuctoria

Greene's tuctoria has been recorded in vernal pools in scattered locations from Shasta County south to Tulare County, and as of 2005, this species was known from approximately 22 extant occurrences in seven California counties (USFWS 2005a). Occurrences of this species in the vicinity of the 2008 Amendment action area are confined to the Vina Plains area of Tehama and Butte Counties. The only 2008 Amendment conservation action that occurs in the vicinity of this species' known populations is the Deer Creek Water Exchange Program in Tehama County, although potential habitat for the species may also be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area. Although the Deer Creek and Mill Creek projects focus primarily on maintaining instream flows by reducing diversions, terrestrial components of these projects' activities include the drilling of groundwater wells (to provide water for agricultural uses that would have otherwise been diverted from Deer and Mill Creeks), operation and maintenance of those wells, surface water monitoring, groundwater monitoring, and fisheries assessment/monitoring.

Greene's tuctoria is known from multiple locations, and the terrestrial activities associated with the Deer Creek and Mill Creek projects will be very limited in extent. Thus, these projects could result in adverse effects to only a fraction of the populations of this species, and 2008 Amendment conservation actions would not jeopardize the continued existence of Greene's tuctoria. During the project-specific section 7 consultations that will occur for individual projects, the effects of the Deer Creek Water Exchange Program, Mill Creek Water Exchange Program, and Mill Creek Water Right Opportunities project on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described to avoid and minimize adverse effects to this species, and that any residual incidental take will be compensated (*e.g.*, through habitat preservation or restoration).

Potential effects of the 2008 Amendment actions on Greene's tuctoria and its designated critical habitat are described below.

Habitat Modification

Because activities associated with the Deer Creek Water Exchange Program, Mill Creek Water Exchange Program, and Mill Creek Water Right Opportunities project that could occur in habitat for Greene's tuctoria are limited, there is a low probability that such activities could modify habitat of this species. Without implementation of appropriate BMPs, adverse effects on habitat could result from changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of well access roads modify runoff patterns. Any grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and other project-related activities could affect vernal pool habitat or runoff patterns in the vicinity of Greene's tuctoria habitat. However, BMPs will be implemented to avoid adverse effects to occupied habitat (see *Best Management Practices* above).

Loss of Individuals

Adverse effects on individuals could result from changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of well access roads modify runoff

patterns, thus reducing the survival and germination of the species. Any grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and other project-related activities could result in trampling of individuals or alteration of conditions for survival and germination of the species. There is also potential for dust generated during project activities to adversely affect individuals by coating leaves, flowers, and seeds which could harm individuals by restricting normal gas exchange and photosynthetic pathways and reduce fecundity. However, BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on Greene's Tuctoria Critical Habitat

Greene's tuctoria critical habitat has been designated (USFWS 2006a), and critical habitat for the species is present in the 2008 Amendment action area on both sides of Deer Creek in the vicinity of the lower reach which is the focus of the Deer Creek Water Exchange Program (critical habitat unit 1). The PCEs of designated critical habitat for Greene's tuctoria are:

- Topographic features characterized by isolated mound and intermound complex within a matrix of surrounding uplands that result in continuously, or intermittently, flowing surface water in the depressional features including swales connecting the pools described below, providing for dispersal and promoting hydroperiods of adequate length in the pools;
- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water or whose soils are saturated for a period long enough to promote germination, flowering, and seed production of predominantly annual native wetland species and typically exclude both native and nonnative upland plant species in all but the driest years. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands.

Without implementation of appropriate BMPs, these PCEs could be adversely affected as described under *Habitat Modification* above. However, BMPs for Greene's tuctoria and other vernal pool species will be implemented during 2008 Amendment actions to avoid and minimize adverse effects to designated critical habitat.

Effects on Colusa Grass

Habitat Modification

Colusa grass typically occurs in large, long-duration, freshwater vernal pools. As of 2005, this species was known from approximately 42 extant occurrences in Yolo, Solano, San Joaquin, Stanislaus, and Merced Counties (USFWS 2005a). Most occurrences are located in the San Joaquin Valley, and the species has not been recorded within the 2008 Amendment action area itself. However, it has been recorded in two areas immediately adjacent to the action area: the

Davis Communications Annex, located immediately west of the Yolo Bypass portion of the action area in Yolo County, and in the Jepson Prairie/Olcott Lake area, located immediately west of the Cache Slough Complex component of the action area in Solano County (USFWS 2005a). It is possible that Colusa grass does not occur in the 2008 Amendment action area and thus would not be affected by these actions. However, given the rarity of the species in the northern part of its range, and the presence of other vernal pool species such as vernal pool and Conservancy fairy shrimp and vernal pool tadpole shrimp in the Glide Tule Elk Reserve in the southwestern part of the Yolo Bypass and in the Elsie Gridley Mitigation Bank area near western edge of the Cache Slough Complex (CNDDB 2008, LSA Associates 2007), a conservative approach has been taken in including this species in the effects analysis and including BMPs for the species.

Restoration activities in the western Cache Slough Complex and activities in the Yolo Bypass have the potential to adversely effect Colusa grass if it is present in these areas. Given that the species has not been recorded within the action area, and given the number of occurrences in the San Joaquin Valley, 2008 Amendment conservation actions could result in adverse effects to only a fraction of the populations of this species, at most, and thus would not jeopardize the continued existence of the species. During the project-specific section 7 consultations that will occur for individual projects, the status of Colusa grass in the project-specific action areas and the effects of these projects on Colusa grass will be analyzed in greater detail. The BMPs previously described will be implemented to avoid and minimize adverse effects to this species, and it is expected that any residual incidental take will be compensated (*e.g.*, through habitat preservation or restoration).

Potential effects of the 2008 Amendment conservation actions on Colusa grass and its designated critical habitat are described below.

Habitat Modification

The 2008 Amendment conservation actions in the Cache Slough Complex would involve restoration of tidal action to areas that are currently nontidal. Activities in the Yolo Bypass would include several modifications that would alter the hydrology of existing habitats to improve fish habitat and passage. In both areas, 2008 Amendment conservation actions have the potential to destroy or alter seasonal pools that may provide habitat for Colusa grass by changing the hydrologic regime supporting vernal pool conditions. More localized loss of habitat could also result from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and other project-related activities, if conducted in occupied habitat in the western Cache Slough Complex or the southwestern part of the Yolo Bypass. However, BMPs (including surveys to determine whether the species is present within Cache Slough Complex and Yolo Bypass project areas) will be implemented to avoid and minimize adverse effects to occupied Colusa grass habitat in all 2008 Amendment conservation action areas where the species could occur (see *Best Management Practices* above).

Loss of Individuals

If 2008 Amendment conservation actions in the western Cache Slough Complex and southwestern Yolo Bypass occur in occupied Colusa grass habitat, these actions could result in the loss of individual plants as a result of changes in the hydrologic regime supporting vernal

pool conditions, thus reducing the survival and germination of the species. Any grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, and trampling by vehicles accessing construction or monitoring areas could result in the loss of plants. There is also potential for dust generated during project activities to adversely affect individuals by coating leaves, flowers, and seeds which could harm individuals by restricting normal gas exchange and photosynthetic pathways and reduce fecundity. BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on Colusa Grass Critical Habitat

Critical habitat for Colusa grass has been designated (USFWS 2006a). Critical habitat unit 1, at the Davis Communications Annex, is located immediately west of the Yolo Bypass, but no designated critical habitat for the species is present in the 2008 Amendment action area. Therefore, the proposed actions will not adversely modify designated critical habitat for Colusa grass.

Effects on Solano Grass

Solano grass occurs in deep, long-duration vernal pools and alkaline playas on soils of the Pescadero series (USFWS 2005a). It has been recorded in only two locations: the Davis Communications Annex, located immediately west of the Yolo Bypass portion of the action area in Yolo County, and the Jepson Prairie/Olcott Lake area, located immediately west of the Cache Slough Complex component of the action area in Solano County (USFWS 2005a). The species is extremely rare; one of the Solano County locations supported only 3 plants in 2005, and at the other Solano County location, the species has not been observed since 1993 (USFWS 2005a). Because none of the locations where Solano grass has been detected are within the 2008 Amendment action area, it is possible that the species does not occur in the action area and thus would not be affected by these actions. However, given the rarity of the species in the northern part of its range, and the presence of other vernal pool species such as vernal pool and Conservancy fairy shrimp and vernal pool tadpole shrimp in the Glide Tule Elk Reserve in the southwestern part of the Yolo Bypass and in the Elsie Gridley Mitigation Bank area near the western edge of the Cache Slough Complex (CNDDB 2008, LSA Associates 2007), a conservative approach has been taken in including this species in the effects analysis and including BMPs for the species.

Restoration activities in the western Cache Slough Complex and activities in the Yolo Bypass have the potential to adversely affect Solano grass if it is present in these areas. Given that the species has not been recorded within the action area, 2008 Amendment conservation actions would not jeopardize the continued existence of the species if BMPs are implemented to ensure that no previously unknown populations are impacted by these actions. During the project-specific section 7 consultations that will occur for individual projects, the status of Solano grass in the project-specific action areas and the effects of these projects on Solano grass will be analyzed in greater detail. The BMPs previously described will be implemented to avoid adverse

effects to this species (given the rarity of the species, projects would avoid impacts to this species to the maximum extent practicable).

Potential effects of the 2008 Amendment conservation actions on Solano grass and its designated critical habitat are described below.

Habitat Modification

The 2008 Amendment conservation actions in the Cache Slough Complex would involve restoration of tidal action to areas that are currently nontidal. Activities in the Yolo Bypass would include several modifications that would alter the hydrology of existing habitats to improve fish habitat and passage. In both areas, 2008 Amendment conservation actions have the potential to destroy or alter seasonal pools that may provide habitat for Solano grass by changing the hydrologic regime supporting vernal pool conditions. More localized loss of habitat could also result from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and other project-related activities, if conducted in occupied habitat in the western Cache Slough Complex or the southwestern part of the Yolo Bypass. BMPs will be implemented to avoid adverse effects to occupied Solano grass habitat in all 2008 Amendment conservation action areas where the species could occur (see *Best Management Practices* above).

Loss of Individuals

If 2008 Amendment conservation actions in the western Cache Slough Complex and southwestern Yolo Bypass occur in occupied Solano grass habitat, these actions could result in the loss of individual plants as a result of changes in the hydrologic regime supporting vernal pool conditions, thus reducing the survival and germination of the species. Any grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, and trampling by vehicles accessing construction or monitoring areas could result in the loss of plants. There is also potential for dust generated during project activities to adversely affect individuals by coating leaves, flowers, and seeds which could harm individuals by restricting normal gas exchange and photosynthetic pathways and reduce fecundity. BMPs will be implemented to avoid adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on Solano Grass Critical Habitat

Critical habitat for Solano grass has been designated (USFWS 2006a). Critical habitat unit 1, at the Davis Communications Annex, is located immediately west of the Yolo Bypass, but no designated critical habitat for the species is present in the 2008 Amendment action area. Therefore, the proposed actions will not adversely modify designated critical habitat for Solano grass.

Effects on Contra Costa Goldfields

Contra Costa goldfields occurs in vernal pools, swales, and moist flats and depressions within grasslands. As of 2005, this species was known from approximately 24 extant occurrences in Mendocino, Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, and Monterey Counties (USFWS 2005a). In the 2008 Amendment action area, Contra Costa goldfields occurs only in the northern portion of the Suisun Marsh area, where there are several scattered occurrence records near the upland edge of the marsh. The CDFG (2005) determined that this species could potentially occur in the Hill Slough West Tidal Restoration project action area and identified measures to avoid and minimize impacts to the species if it is present. Given the presence of records from the Suisun Marsh, the species could potentially be present in the Meins Landing project area as well.

Restoration activities in the Suisun Marsh have some potential to adversely affect Contra Costa goldfields, primarily by altering hydrology in areas supporting the species (*i.e.*, restoring tidal action to areas that are currently diked). Given the occurrence of Contra Costa goldfields in multiple locations outside the action area, 2008 Amendment conservation actions could result in adverse effects to only a fraction of the populations of this species, at most, and thus would not jeopardize the continued existence of the species. During the project-specific section 7 consultations that will occur for individual projects, the effects of these projects on Contra Costa goldfields will be analyzed in greater detail. The BMPs previously described will be implemented to avoid and minimize adverse effects to this species, and it is expected that any residual incidental take will be compensated (*e.g.*, through habitat preservation or restoration).

Potential effects of the 2008 Amendment conservation actions on Contra Costa goldfields and its designated critical habitat are described below.

Habitat Modification

Conservation actions in the Suisun Marsh would consist of tidal marsh restoration projects, and if Contra Costa goldfields is present in the diked marshes that would be subject to such restoration, then habitat for the species would be lost due to the restoration of tidal hydrology. More localized loss of Contra Costa goldfields habitat could also result from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and other project-related activities, if conducted in occupied habitat.

BMPs will be implemented to avoid and minimize adverse effects to occupied Contra Costa goldfields habitat in all 2008 Amendment conservation action areas where the species could occur (see *Best Management Practices* above) to minimize impacts to this species' habitat.

Loss of Individuals

If 2008 Amendment conservation actions in the Suisun Marsh occur in occupied Contra Costa goldfields habitat, these actions could result in the loss of individual plants as a result of changes in the hydrologic regime supporting suitable habitat, thus reducing the survival and germination of the species. Any grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, and trampling by vehicles accessing construction or monitoring areas could result in the loss of plants. There is also potential for dust generated

during project activities to adversely affect individuals by coating leaves, flowers, and seeds which could harm individuals by restricting normal gas exchange and photosynthetic pathways and reduce fecundity. BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on Contra Costa Goldfields Critical Habitat

Critical habitat for Contra Costa goldfields has been designated (USFWS 2006a), and critical habitat units 4C, 5A, and 5B occur within the upper margins of the Suisun Marsh component of the 2008 Amendment action area. The PCEs of designated critical habitat for Contra Costa goldfields are:

- Topographic features characterized by isolated mound and intermound complex within a matrix of surrounding uplands that result in continuously, or intermittently, flowing surface water in the depressional features including swales connecting the pools described below, providing for dispersal and promoting hydroperiods of adequate length in the pools;
- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water or whose soils are saturated for a period long enough to promote germination, flowering, and seed production of predominantly annual native wetland species and typically exclude both native and nonnative upland plant species in all but the driest years. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands.

Without implementation of appropriate BMPs, these PCEs could be adversely affected as described under *Habitat Modification* above. However, BMPs for Contra Costa goldfields and other vernal pool species will be implemented during 2008 Amendment conservation actions to avoid and minimize adverse effects to designated critical habitat.

Effects on Conservancy Fairy Shrimp

The Conservancy fairy shrimp has been documented in large, moderately turbid vernal pools in eight populations ranging from the Vina Plains area of Butte and Tehama Counties south to Los Padres National Forest in Ventura County (USFWS 2007a). In the 2008 Amendment action area, Conservancy fairy shrimp occur in a limited area in the Glide Tule Elk Reserve in the southwestern part of the Yolo Bypass; at the base of the Potrero Hills along the northeastern edge of the Suisun Marsh area; and in the Vina Plains Preserve area in Tehama and Butte Counties, immediately south of the Deer Creek Flow Enhancement Program. Potential habitat for the species may also be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area. Although the Deer Creek and Mill Creek projects focus primarily on maintaining instream flows by reducing diversions, terrestrial components of these projects' activities include the drilling of groundwater wells (to provide water for agricultural uses that would have otherwise been diverted from Deer and Mill Creeks),

operation and maintenance of those wells, surface water monitoring, groundwater monitoring, and fisheries assessment/monitoring.

The CDFG (2005) determined that no listed vernal pool branchiopods were present within the Hill Slough West Tidal Restoration project action area, and the species is unlikely to be present in the Meins Landing project area either. This species occurs in vernal pools at the base of the Potrero Hills (on the northern side of these hills), but these hills are excluded from the 2008 Amendment action area since they are unsuitable for tidal restoration or other activities to benefit the target fish species. Therefore, there is a low potential for Suisun Marsh conservation actions to affect this species

Restoration activities in the Yolo Bypass and Suisun Marsh have some potential to adversely affect the Conservancy fairy shrimp primarily by altering hydrology in areas supporting the species. The terrestrial activities associated with the 2008 Amendment conservation actions at Deer Creek and Mill Creek will also be very limited in extent. The Conservancy fairy shrimp is known from only eight locations (USFWS 2007a), and thus, impacts on the species at any one location could have population-level effects. However, with implementation of the BMPs for this and other vernal pool species previously described, 2008 Amendment conservation actions would not jeopardize the continued existence of the species. During the project-specific section 7 consultations that will occur for individual projects, the effects of these projects on the Conservancy fairy shrimp will be analyzed in greater detail. BMPs will be implemented to avoid adverse effects to this species.

Potential effects of the 2008 Amendment conservation actions on the Conservancy fairy shrimp and its designated critical habitat are described below.

Habitat Modification

The 2008 Amendment conservation actions in the Yolo Bypass would include several modifications that would alter the hydrology of existing habitats to improve fish habitat and passage. Tidal restoration in the Suisun Marsh could also affect habitat of this species, if it is present in the upland edges of areas to be restored. In the absence of BMPs, these activities could potentially destroy or alter the hydrology of seasonal pools that currently support occurrences of Conservancy fairy shrimp. More localized loss of Conservancy fairy shrimp habitat could also result from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and other project-related activities, if conducted in occupied habitat.

Only limited activities associated with the Deer Creek Water Exchange Program and the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project could occur in habitat for the Conservancy fairy shrimp, since these projects focus on maintaining flow in stream habitats that are not suitable for this species. As a result, there is a low probability that such activities would modify habitat of this species. Without implementation of appropriate BMPs, adverse effects on habitat could result from changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of access roads modify runoff patterns. Any grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and other project-related

activities could affect vernal pool habitat or runoff patterns in the vicinity of Conservancy fairy shrimp habitat.

BMPs will be implemented to avoid adverse effects to occupied Conservancy fairy shrimp habitat in all 2008 Amendment conservation action areas where the species could occur (see *Best Management Practices* above). Due to the relative rarity of this species, BMPs will focus on avoidance of impacts to the maximum extent practicable.

Loss of Individuals

If 2008 Amendment conservation actions in the southwestern Yolo Bypass, northeastern Suisun Marsh, Deer Creek Water Exchange Program, Mill Creek Water Exchange Program, or Mill Creek Water Right Opportunities project areas occur in occupied Conservancy fairy shrimp habitat, these actions could result in the mortality of individual fairy shrimp and their cysts as a result of grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, trampling by vehicles accessing construction or monitoring areas, and well-drilling. BMPs will be implemented to avoid adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on Conservancy Fairy Shrimp Critical Habitat

Critical habitat for the Conservancy fairy shrimp has been designated (USFWS 2006a), and critical habitat for the species is present in the 2008 Amendment action area immediately southeast of the lower reach of Deer Creek, which is the focus of the Deer Creek Water Exchange Program (critical habitat unit 1A) and in the Potrero Hills along the northeastern edge of the Suisun Marsh area (critical habitat unit 3).

The PCEs of designated critical habitat for Conservancy fairy shrimp are:

- Topographic features characterized by mounds, swales, and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools described below, providing for dispersal and promoting hydroperiods of adequate length in the pools;
- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum of 19 days, in all but the driest years; thereby providing adequate water for incubation, maturation, and reproduction. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands;
- Sources of food, expected to be detritus occurring in the pools, contributed by overland flow from the pools' watershed, or the results of biological processes within the pools themselves, such as single-celled bacteria, algae, and dead organic matter, to provide for feeding;
- Structure within the pools described above, consisting of organic and inorganic materials, such as living and dead plants from plant species adapted to seasonally inundated

environments, rocks, and other inorganic debris that may be washed, blown, or otherwise transported into the pools, that provide shelter.

Without implementation of appropriate BMPs, these PCEs could be adversely affected as described under *Habitat Modification* above. However, BMPs for Conservancy fairy shrimp and other vernal pool species will be implemented to avoid adverse effects to designated critical habitat.

Effects on Vernal Pool Fairy Shrimp

The vernal pool fairy shrimp occurs in vernal pools having a wide range of conditions, vegetation types, substrates, and sizes. This species occurs fairly widely, with 395 occurrences in 25 California counties (plus Jackson County, Oregon) known as of 2006 (USFWS 2007b). This species is found in a number of widely scattered areas from southern Oregon south through the Central Valley and in fewer locations in the coast ranges from the vicinity of San Francisco Bay area south to Riverside County. In the 2008 Amendment action area, vernal pool fairy shrimp occur in a limited area in the Glide Tule Elk Reserve in the southwestern part of the Yolo Bypass; at the base of the Potrero Hills near the northeastern portion of the Suisun Marsh area; and in the Vina Plains Preserve area in Tehama and Butte Counties, immediately south of the Deer Creek Flow Enhancement Program. Potential habitat for the species may also be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area. Although the Deer Creek and Mill Creek projects focus primarily on maintaining instream flows by reducing diversions, terrestrial components of these projects' activities include the drilling of groundwater wells (to provide water for agricultural uses that would have otherwise been diverted from Deer and Mill Creeks), operation and maintenance of those wells, surface water monitoring, groundwater monitoring, and fisheries assessment/monitoring.

The CDFG (2005) determined that no listed vernal pool branchiopods were present within the Hill Slough West Tidal Restoration project action area, and the species is unlikely to be present in the Meins Landing project area either. In the Suisun Marsh area, this species occurs in vernal pools at the base of the Potrero Hills (on the northern side of these hills), but these hills are excluded from the 2008 Amendment action area since they are unsuitable for tidal restoration or other activities to benefit the target fish species. Therefore, there is a low potential for Suisun Marsh conservation actions to affect this species

Restoration activities in the Yolo Bypass and Suisun Marsh have some potential to adversely affect the vernal pool fairy shrimp primarily by altering hydrology in areas supporting the species, although Suisun Marsh restoration projects would be unlikely to occur in habitat suitable for this species, and Yolo Bypass activities could affect few populations. The terrestrial activities associated with the 2008 Amendment conservation actions at Deer Creek and Mill Creek will also be very limited in extent. The vernal pool fairy shrimp is known from multiple locations; as of 2006, it was known from 395 occurrences in 25 California counties (USFWS 2007b). Collectively, 2008 Amendment conservation actions could result in adverse effects to

only a fraction of the populations of this species, and thus would not jeopardize the continued existence of the species. During the project-specific section 7 consultations that will occur for individual projects, the effects of these projects on the vernal pool fairy shrimp will be analyzed in greater detail. The BMPs previously described will be implemented to avoid and minimize adverse effects to this species, and it is expected that any residual incidental take will be compensated (*e.g.*, through habitat preservation or restoration).

Potential effects of the 2008 Amendment conservation actions on the vernal pool fairy shrimp and its designated critical habitat are described below.

Habitat Modification

The 2008 Amendment conservation actions in the Yolo Bypass would include several modifications that would alter the hydrology of existing habitats to improve fish habitat and passage. If tidal restoration occurs along the northeastern edge of the Suisun Marsh, and if vernal pool fairy shrimp are present in the diked marshes that would be subject to such restoration, then habitat for the species would be lost due to the restoration of tidal hydrology. These activities in the Yolo Bypass and Suisun Marsh could potentially destroy or alter the hydrology of seasonal pools that currently support occurrences of vernal pool fairy shrimp. More localized loss of vernal pool fairy shrimp habitat could also result from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and other project-related activities, if conducted in occupied habitat in the southwestern part of the Yolo Bypass.

Only limited activities associated with the Deer Creek Water Exchange Program and the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project could occur in habitat for the vernal pool fairy shrimp, since these projects focus on maintaining flow in stream habitats that are not suitable for this species. As a result, there is a low probability that such activities would modify habitat of this species. Without implementation of appropriate BMPs, adverse effects on habitat could result from changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of access roads modify runoff patterns. Any grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and other project-related activities could affect vernal pool habitat or runoff patterns in the vicinity of vernal pool fairy shrimp habitat.

BMPs will be implemented to avoid and minimize adverse effects to occupied vernal pool fairy shrimp habitat in all 2008 Amendment conservation action areas where the species could occur (see *Best Management Practices* above).

Loss of Individuals

If 2008 Amendment conservation actions in the southwestern Yolo Bypass, Suisun Marsh, Deer Creek Water Exchange Program, Mill Creek Water Exchange Program, or Mill Creek Water Right Opportunities project areas occur in occupied vernal pool fairy shrimp habitat, these actions could result in the mortality of individual fairy shrimp and their cysts as a result of grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, trampling by vehicles accessing construction or monitoring areas, and well-

drilling. BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on Vernal Pool Fairy Shrimp Critical Habitat

Critical habitat for the vernal pool fairy shrimp has been designated (USFWS 2006a), and critical habitat for the species is present in the 2008 Amendment action area immediately southeast of the lower reach of Deer Creek, which is the focus of the Deer Creek Water Exchange Program (critical habitat unit 7A), and in the Potrero Hills along the northeastern edge of the Suisun Marsh area (critical habitat unit 16A).

The PCEs of designated critical habitat for vernal pool fairy shrimp are:

- Topographic features characterized by mounds, swales, and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools described below, providing for dispersal and promoting hydroperiods of adequate length in the pools;
- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum of 18 days, in all but the driest years; thereby providing adequate water for incubation, maturation, and reproduction. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands;
- Sources of food, expected to be detritus occurring in the pools, contributed by overland flow from the pools' watershed, or the results of biological processes within the pools themselves, such as single-celled bacteria, algae, and dead organic matter, to provide for feeding;
- Structure within the pools described above, consisting of organic and inorganic materials, such as living and dead plants from plant species adapted to seasonally inundated environments, rocks, and other inorganic debris that may be washed, blown, or otherwise transported into the pools, that provide shelter.

Without implementation of appropriate BMPs, these PCEs could be adversely affected as described under *Habitat Modification* above. However, BMPs for vernal pool fairy shrimp and other vernal pool species will be implemented to avoid and minimize adverse effects to designated critical habitat.

Effects on Vernal Pool Tadpole Shrimp

The vernal pool tadpole shrimp occurs in sparsely vegetated, muddy or grass-bottomed vernal pools and swales on old alluvial soils that are underlaid by hardpan (USFWS 1994). This species occurs fairly widely, with 226 occurrences in 19 California counties (plus Jackson County, Oregon) known as of 2006 (USFWS 2007c). This species is found in a number of widely scattered areas in the Central Valley, from Shasta County south into the San Joaquin Valley (with outlying occurrences in Contra Costa and Alameda Counties). In the 2008 Amendment action area, vernal pool tadpole shrimp occur in a limited area in the Glide Tule Elk Reserve in the southwestern part of the Yolo Bypass; at the base of the Potrero Hills near the northeastern portion of the Suisun Marsh area; in the Montezuma Wetlands project area in the eastern portion of the Suisun Marsh; and in the Elsie Gridley Mitigation Bank and vicinity at the very western edge of the Cache Slough Complex. If tidal restoration were to occur in areas providing occupied vernal pool tadpole shrimp habitat, or if other 2008 Amendment conservation actions in these areas were to modify the hydrology of pools supporting the species, adverse effects to the tadpole shrimp could occur.

Vernal pool tadpole shrimp also occur in the 2008 Amendment action area at the Vina Plains Preserve area in Tehama and Butte Counties, immediately south of the Deer Creek Flow Enhancement Program, and potential habitat for the species may be present in pools north and south of the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project area. Although these projects focus primarily on maintaining instream flows by reducing diversions, terrestrial components of these projects' activities include the drilling of groundwater wells (to provide water for agricultural uses that would have otherwise been diverted from Deer and Mill Creeks), operation and maintenance of those wells, surface water monitoring, groundwater monitoring, and fisheries assessment/monitoring. Tadpole shrimp are also present in the area on the south side of Battle Creek near the Battle Creek Salmon and Steelhead Restoration project area. The 2005 EIR (Jones & Stokes 2005) for the Battle Creek project did not identify any potential impacts to tadpole shrimp, and the project may avoid this species. However, because the means to access each component of this project during and after construction and the details of monitoring have not yet been identified, there is some potential for Battle Creek project activities to affect vernal pool tadpole shrimp.

Restoration activities in the western Cache Slough Complex and activities in the Yolo Bypass have the potential to adversely affect several occurrences of the vernal pool tadpole shrimp. In the Suisun Marsh, the CDFG (2005) determined that no listed vernal pool branchiopods were present within the Hill Slough West Tidal Restoration project action area. In the Suisun Marsh area, this species occurs in vernal pools at the base of the Potrero Hills (on the northern side of these hills), but these hills are excluded from the 2008 Amendment action area since they are unsuitable for tidal restoration or other activities to benefit the target fish species. Therefore, there is a low potential for Suisun Marsh conservation actions to affect this species.

In contrast, the terrestrial activities associated with the 2008 Amendment conservation actions at Deer Creek, Mill Creek, and Battle Creek will be very limited in extent. The vernal pool tadpole shrimp is known from multiple locations; as of 2007, it was known from 226 occurrences in 19 counties (USFWS 2007c). Collectively, 2008 Amendment conservation actions could result in adverse effects to only a fraction of the populations of this species, and thus would not

jeopardize the continued existence of the species. During the project-specific section 7 consultations that will occur for individual projects, the effects of these projects on the vernal pool tadpole shrimp will be analyzed in greater detail. The BMPs previously described will be implemented to avoid and minimize adverse effects to this species, and it is expected that any residual incidental take will be compensated (*e.g.*, through habitat preservation or restoration).

Potential effects of the 2008 Amendment conservation actions on the vernal pool tadpole shrimp and its designated critical habitat are described below.

Habitat Modification

The 2008 Amendment conservation actions in the Cache Slough Complex would involve restoration of tidal action to areas that are currently nontidal. Activities in the Yolo Bypass would include several modifications that would alter the hydrology of existing habitats to improve fish habitat and passage. In both areas, 2008 Amendment conservation actions have the potential to destroy or alter seasonal pools that currently support occurrences of vernal pool tadpole shrimp. In the Suisun Marsh, the CDFG (2005) determined that vernal pool tadpole shrimp were absent from the Hill Slough West Tidal Restoration project area. It is unknown whether the Meins Landing Tidal Restoration project area provides suitable habitat for this species. Although the diked marsh of this former duck club would seem unsuitable for the species, the site is immediately adjacent to the Montezuma Wetlands project where vernal pool tadpole shrimp have been recorded. Restoration of tidal action to diked marshes or uplands containing this species would result in the loss of tadpole shrimp habitat.

More localized loss of vernal pool tadpole shrimp habitat could also result from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and other project-related activities, if conducted in occupied habitat in the western Cache Slough Complex or the southwestern part of the Yolo Bypass. Adverse effects on habitat could also result from changes in the hydrologic regime supporting vernal pool conditions.

Only limited activities associated with the Deer Creek Water Exchange Program, the Mill Creek Water Exchange Program/Mill Creek Water Right Opportunities project, and the Battle Creek Salmon and Steelhead Restoration project could occur in habitat for the vernal pool tadpole shrimp, since these projects focus on stream habitats that are not suitable for this species. As a result, there is a low probability that such activities would modify habitat of this species. Without implementation of appropriate BMPs, adverse effects on habitat could result from changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of access roads modify runoff patterns. Any grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and other project-related activities could affect vernal pool habitat or runoff patterns in the vicinity of tadpole shrimp habitat.

BMPs will be implemented to avoid and minimize adverse effects to occupied vernal pool tadpole shrimp habitat in all 2008 Amendment conservation action areas where the species could occur (see *Best Management Practices* above).

Loss of Individuals

If 2008 Amendment conservation actions in the western Cache Slough Complex, southwestern Yolo Bypass, Suisun Marsh, or the Deer Creek Water Exchange Program, Mill Creek Water Exchange Program, Mill Creek Water Right Opportunities, and Battle Creek Salmon and Steelhead Restoration project areas occur in occupied vernal pool tadpole shrimp habitat, these actions could result in the mortality of individual tadpole shrimp and their cysts as a result of grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, trampling by vehicles accessing construction or monitoring areas, and well-drilling. BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on Vernal Pool Tadpole Shrimp Critical Habitat

Critical habitat for the vernal pool tadpole shrimp has been designated (USFWS 2006a), and critical habitat for the species is present in the 2008 Amendment action area along the south side of Battle Creek in the vicinity of the Battle Creek Salmon and Steelhead Restoration project (critical habitat unit 2B); immediately southeast of the lower reach of Deer Creek, which is the focus of the Deer Creek Water Exchange Program (critical habitat unit 3A); and in the Potrero Hills along the northeastern edge of the Suisun Marsh area (critical habitat unit 11D).

The PCEs of designated critical habitat for vernal pool tadpole shrimp are:

- Topographic features characterized by mounds and swales and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools described below, providing for dispersal and promoting hydroperiods of adequate length in the pools;
- Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum of 41 days, in all but the driest years; thereby providing adequate water for incubation, maturation, and reproduction. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands;
- Sources of food, expected to be detritus occurring in the pools, contributed by overland flow from the pools' watershed, or the results of biological processes within the pools themselves, such as single-celled bacteria, algae, and dead organic matter, to provide for feeding;
- Structure within the pools described above, consisting of organic and inorganic materials, such as living and dead plants from plant species adapted to seasonally inundated environments, rocks, and other inorganic debris that may be washed, blown, or otherwise transported into the pools, that provide shelter.

Without implementation of appropriate BMPs, these PCEs could be adversely affected as described under *Habitat Modification* above. However, BMPs for vernal pool tadpole shrimp

and other vernal pool species will be implemented to avoid and minimize adverse effects to designated critical habitat.

Effects on Valley Elderberry Longhorn Beetle

The valley elderberry longhorn beetle is usually found in close association with its host plant, the elderberry, in riparian areas and floodplains in the Central Valley. Originally thought to be very rare when it was listed in 1980, the species has since been recorded in approximately 190 locations (USFWS 2008). CNDDB (2008) records in the vicinity of the 2008 Amendment action area include records along the Sacramento River in the northern Yolo Bypass area (near the Fremont Weir project and at locations both north and south of the Yolo Bypass tie-in to the Sacramento River on the northwest side of the Sacramento River). This species is also present along the Sacramento River near the 2008 Amendment conservation action areas in the northern Sacramento Valley. Jones & Stokes (2005) indicated that suitable habitat is present at a number of dams in the Battle Creek Salmon and Steelhead Restoration project, and because this species occurs along at least the lower portions of several tributaries to the Sacramento River in this area, it could potentially be present in the action areas for the Battle Creek Salmon and Steelhead Restoration project, Deer Creek Flow Enhancement Program, Mill Creek Water Exchange Program, Mill Creek Water Right Opportunities project, and Parrott Phelan and Durham Mutual Dam fish ladder and screen maintenance project. Elderberry shrubs are present on levees in some parts of the Delta as well. Although there are no CNDDB records of the valley elderberry longhorn beetle in the Delta, the USACE and CDWR (2001) determined that elderberry shrubs along the northern portion of the ship channel at Prospect Island could potentially support the longhorn beetle, and this species could occur along levees and in riparian areas at other potential project sites in the Delta.

The valley elderberry longhorn beetle is known from approximately 190 locations, and collectively, 2008 Amendment actions could result in adverse effects to only a fraction of the populations of this species and thus would not jeopardize the continued existence of the species. Given the apparently low abundance of the valley elderberry longhorn beetle in the majority of the Delta and Yolo Bypass (at least, based on CNDDB records), it is possible that restoration in the Delta and Yolo Bypass will benefit the valley elderberry longhorn beetle by providing extensive natural riparian habitat restoration, as suitable conditions for elderberry shrubs at the upper edges of restored marshes and in floodplains will increase. If so, these benefits would more than offset project-related adverse effects to the species, thus helping to contribute to its recovery.

During the project-specific section 7 consultations that will occur for individual projects, the effects of these projects on the valley elderberry longhorn beetle will be analyzed in greater detail. The BMPs previously described will be implemented to avoid and minimize adverse effects to this species, and it is expected that any residual incidental take will be compensated (*e.g.*, through habitat preservation or restoration).

Potential effects of the 2008 Amendment actions on the valley elderberry longhorn beetle and its designated critical habitat are described below.

Habitat Modification

The 2008 Amendment actions in the Cache Slough Complex and other areas in the Delta would involve restoration of tidal action to areas that are currently nontidal. Activities in the Yolo Bypass could include a number of activities that could result in large-scale alteration of the hydrology of existing habitats and much more localized direct effects on habitats. In both areas, 2008 Amendment conservation actions could result in the loss of elderberries on which this beetle depends due to clearing, grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and other project-related activities. Adverse effects on habitat could also result from changes in the hydrologic regime supporting elderberry plants (most likely by increasing the flooding frequency and duration). In some areas, such flooding is likely to kill existing elderberries. However, given the scale of these restoration efforts and the apparently low abundance of the valley elderberry longhorn beetle from the majority of the Delta and Yolo Bypass (at least, based on CNDDB records), it is even more likely that restoration will benefit the species by providing extensive natural riparian habitat restoration, as suitable conditions for elderberry shrubs at the upper edges of restored marshes and in floodplains will increase.

Only limited activities associated with the Battle Creek Salmon and Steelhead Restoration project, Deer Creek Flow Enhancement Program, Mill Creek Water Exchange Program, Mill Creek Water Right Opportunities project, and Parrott Phelan and Durham Mutual Dam fish ladder and screen maintenance project would occur in terrestrial areas where the valley elderberry longhorn beetle might occur, since these projects focus on stream habitats that are not suitable for this species. As a result, there is a low probability that such activities would modify habitat of this species. Without implementation of appropriate BMPs, there is some potential for adverse effects on habitat from clearing and grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and other project-related activities.

BMPs will be implemented to avoid and minimize adverse effects to occupied valley elderberry longhorn beetle habitat in all 2008 Amendment project areas where the species could occur (see *Best Management Practices* above) to minimize impacts to this species' habitat.

Loss of Individuals

If conservation actions in the Delta, Yolo Bypass, Deer Creek Water Exchange Program, Mill Creek Water Exchange Program, Mill Creek Water Right Opportunities project, Battle Creek Salmon and Steelhead Restoration project, and Parrott Phelan and Durham Mutual Dam project areas occur in occupied valley elderberry longhorn beetle habitat, or result in the loss of elderberry shrubs, these actions could result in the mortality of individual longhorn beetles as a result of clearing, grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, trampling by vehicles accessing construction or monitoring areas, and well-drilling. BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on Valley Elderberry Longhorn Beetle Critical Habitat

Critical habitat for the valley elderberry longhorn beetle has been designated, but is restricted to small areas in Sacramento County (USFWS 1980) outside the 2008 Amendment action area. Therefore, these actions will not result in the adverse modification of designated critical habitat for this species.

Effects on Sacramento River Winter-run Chinook Salmon

The effects of diversions and entrainment of winter-run Chinook salmon by operational aspects of the OCAP are discussed in sections of this biological assessment pertaining to pump operations. The following section focuses on the effects (overwhelmingly beneficial) of the 2008 Amendment conservation actions on winter-run Chinook salmon.

Winter-run Chinook salmon have lost access to approximately 58 percent of their original habitat due to dam construction; currently winter-run spawn below Keswick Dam in the mainstem Sacramento River. Juvenile winter-run outmigrate through the Delta from January through April, but the range of outmigration can extend from September to June, with pulses coinciding with high precipitation and increased turbidity. The 2008 Amendment conservation actions in the Yolo Bypass, the Delta, and Suisun Marsh may result in short-term adverse effects to outmigrating juveniles. However, because these projects will restore and enhance habitat conditions for outmigrants in the long-term, these projects will not jeopardize the continued existence of the species and will not adversely modify designated critical habitat. On the contrary, these conservation actions will have a net benefit to the species, helping to contribute to its recovery. The Spring-run Warden Overtime project will provide protection to holding and spawning adult winter-run Chinook salmon as well, which should decrease risk of mortality due to poaching or other illegal activities and provide a net benefit.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for aquatic species and habitat quality, and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating).

Potential effects of the 2008 Amendment actions on winter-run Chinook salmon and designated critical habitat are described below.

Habitat Modification

Although the timing of juvenile winter-run Chinook outmigration through the Delta is known based on existing monitoring, specific habitats utilized by outmigrating winter-run are poorly understood. However, the recovery plan indicates that until specific information is available for winter-run in estuaries, it is assumed that the importance and use of estuarine habitat for winter-run is similar to other salmon populations (NMFS 1997). In general, NMFS (1997) noted for salmonids in estuaries that…

> …juvenile salmon forage in intertidal and shallow subtidal areas, specifically in marsh, mudflat, channel, slough, or bay habitats. These habitats provide both a rich food supply and protective cover within shallow turbid waters (McDonald 1960, Dunford 1975; cited from Cannon 1981). The distribution of juvenile chinook changes tidally, with fry moving from tidal channels during flood tide to feed in near-shore marshes (Healey 1991, Levy and Northcote 1981, Levings 1982). Chinook fry scatter along the edges of marshes at the highest points reached by the tide, then with the receding tide, retreat into tidal channels that dissect marsh areas and retain water at low tide. Larger fry and smolts tend to congregate in surface waters of main and subsidiary sloughs channels and move into shallow subtidal areas to feed (Allen and Hassler 1986).

Specific information on what is known about salmonid use of the Delta is:

1) Juvenile Chinook salmon do rear in the estuary but use of specific habitat types is not well known, as most evaluations have been conducted using beach seines which do not sample efficiently in vegetation or on rock/rip-rap substrates and in water >1m deep (California Department of Water Resources Interagency Ecological Program 2006).
2) Growth rates appear to be relatively slow during outmigration when compared to other salmonids in other estuary systems (MacFarlane and Norton 2002).
3) Juvenile Chinook salmon feed predominantly on chironomid larvae and pupae (more typical of emergent marsh) as well as the amphipod *Hyallela azteca* and tend to occur in more "open water" than in association with submerged vegetation (Williams 2006, Simenstad *et al.* 2000).
4) Water temperatures >15°C tend to favor non-native fish assemblages (CALFED Bay Delta Science Program 2001, California Department of Water Resources Interagency Ecological Program 2006).
5) Seasonally inundated floodplain habitat (*e.g.*, Yolo Bypass) provides important rearing habitat enhancing growth and survival of outmigrating juvenile Chinook salmon (Sommer *et al.* 2001, Sommer *et al.* 2005), although stranding can occur associated with engineered water control structures such as weirs (Sommer *et al.* 2005).

The Battle Creek Salmon and Steelhead Restoration project will restore access to suitable habitat, increase minimum instream flows, provide cooler water temperatures, and provide other benefits for winter-run Chinook salmon (Jones & Stokes Associates 2005). Short-term mortality, reduced reproductive success, and reduced growth rates could potentially occur as a result of physical disturbance, noise, sedimentation, and accidental spills of chemicals or materials during project activities, as well as the release of sediments stored behind dams that are to be removed. However, such adverse effects will be short-term and limited compared to the overwhelming benefits of the project, which is considered beneficial for the recovery of the ESU in order to create a second naturally spawning population (NMFS 2007).

The 2008 Amendment conservation actions in the Yolo Bypass, western Delta and Suisun Marsh will improve survival and growth of juvenile winter-run Chinook salmon by increasing and improving floodplain and estuarine rearing and outmigration habitat. Juvenile Chinook salmon should benefit from projects to improve connectivity and reduce stranding risk associated with engineered weirs in the Yolo Bypass, such as the Lisbon weir improvements, additional multi-species floodplain habitat development improvements, Tule Canal conductivity improvements, and Fremont Weir fish passage improvements. The 2008 Amendment conservation actions in estuarine habitat used by juvenile winter-run Chinook salmon, including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex, and restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh, will consist of tidal restoration projects that are expected to be beneficial. Habitat quality is expected to increase by increasing tidally inundated shallow water habitat and marsh ecotones, thus improving the food base and habitat conditions for juvenile rearing and outmigration. Potential short-term adverse effects may occur associated with grading, excavation, placement of fill for levees or berms, and movement of heavy equipment and vehicles, which could result in increased turbidity and suspended sediment, as well as potentially resulting in toxic spills. However, BMPs will be implemented to minimize or avoid any such adverse effects. Potential short-term effects, such as increased turbidity and suspended sediment, may also occur following breaching of levees during early stages of flooding until aquatic food webs can establish and initial erosion has occurred; however, BMPs to limit breaching to times of year when target fish species are not present should minimize or avoid any such adverse effects. In addition, there is some evidence that increased turbidity can moderate effects of predation on juvenile salmonids (Nobriga *et al.* 2005).

The 2008 Amendment conservation actions in estuarine habitat used by juvenile winter-run Chinook salmon, including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex, and restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh potentially could result in poor water quality conditions for juvenile winter-run, such as low dissolved oxygen and contaminants, and could provide habitat for non-native aquatic plants and predatory fish species. However, Aquatic and Wetland Species/Water Quality BMPs will be implemented to minimize or avoid any such adverse effects. Given that the projects are expected to result in full tidal circulation, it is unlikely that dissolved oxygen levels will adversely affect juvenile winter-run. The effects of such tidal restoration on mercury methylation are difficult to predict, but some accumulation of mercury in the food web could occur (Brown 2003). Invasive aquatic plant species (*e.g.*, Brazilian waterweed and water hyacinth) have been documented to provide habitat for non-native fish species over native fish species (Brown 2003). Efforts to restore tidal wetland and subtidal habitats will consider approaches to minimize the risk of invasion of non-native aquatic plant species (Brown 2003). In addition, water quality, non-native aquatic plants, and non-native predatory fish species will be monitored and addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Non-native fish are commonly distributed in the Yolo Bypass, the Delta, and Suisun Marsh (Nobriga *et al.* 2005, Feyrer and Healey 2003, Feyer *et al.* 2006, Matern *et al.* 2002, Simenstad *et al.* 2000), although the highest proportions of native fish species occur in the northern Delta (Brown and Michniuk 2007). Many of the non-native species, such as largemouth bass and striped bass, are known predators on smaller fish such as juvenile salmonids. The 2008 Amendment conservation actions identified in the Yolo Bypass, the Delta, and Suisun Marsh are likely to provide habitat for these predatory non-native fish species; however, juvenile salmonids are most likely to occur in the restoration sites in the winter and spring when water temperature is at its coldest, which will decrease the potential for overlap between non-native predators and native fish. One of the goals of the conservation actions will be to limit the type of habitat used by non-native fish predators, thereby potentially reducing predation. Non-native predatory fish species will be monitored and addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Effects on Sacramento River Winter-run Chinook Salmon Critical Habitat

Critical habitat has been designed in the Sacramento River from Keswick Dam (RM302) to Chipps Island (RM0) and all waters west from Chipps Island to the Golden Gate Bridge (NMFS 1993). Battle Creek is not within designated critical habitat, although 2008 Amendment conservation actions are proposed there to benefit winter-run Chinook salmon. The remaining 2008 Amendment conservation actions proposed in the Yolo Bypass (including the Lisbon weir improvements, additional multi-species floodplain habitat development improvements, Tule Canal conductivity improvements, and Fremont Weir fish passage improvements), the Delta (including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex), and the Suisun Marsh (including restoration of tidal marsh at Hill Slough West and Meins Landing) are within designated critical habitat. PCEs of designated critical habitat for winter-run Chinook salmon includes:

- Access from the Pacific Ocean to appropriate spawning areas of the upper Sacramento River
- Availability of clean gravel for spawning substrate
- Adequate river flows for successful spawning, egg incubation, fry development and emergence, and downstream transport of juveniles
- Water temperatures between 42.5 and 57.5°F for successful spawning, egg incubation, and fry development
- Habitat areas and adequate prey that are not contaminated
- Riparian habitat that provides for successful juvenile development and survival
- Access downstream so that juveniles can migrate from spawning grounds to the San Francisco Bay and Pacific Ocean.

The 2008 Amendment conservation actions in the Delta and Suisun Marsh will restore tidal circulation and tidal marsh, as is proposed for the western Cache Slough Complex and Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex and the Hill Slough West Tidal Marsh Restoration projects. The evolution of tidal marsh habitat will occur over time, with potential for some initial short-term adverse effects to designated critical habitat until conditions equilibrate. These short-term effects are likely to include short-term increases in turbidity associated with initial breaching. Potential longer term effects to designated critical habitat, such as low dissolved oxygen, contaminants, mercury accumulation in the food web, or invasion by non-native aquatic plants, will be monitored and addressed in the Adaptive Management Plan. In the long-term, the fully tidal marshes that will be restored are likely to provide essential foraging habitat and food resources used by juvenile winter-run; monitoring and adaptive management described in the Adaptive Management Plan will be used to evaluate and modify projects to make sure that the projects will not adversely modify critical habitat and will instead contribute to the recovery of winter-run Chinook salmon.

Effects on Central Valley Spring-run Chinook Salmon

Central Valley spring-run Chinook salmon populations once occupied the headwaters of all major river systems in the Central Valley up to any natural barrier (Yoshiyama *et al.* 1996, 1998); spring-run have lost access to a substantial amount (up to 82%) of their original habitat due to dam construction. Currently, the bulk of the remaining spring-run Chinook salmon are produced in Deer, Mill, and Butte Creeks, the Feather River, and perhaps the main stem Sacramento River. Juvenile spring-run rear in natal tributaries, the mainstem Sacramento River, non-natal tributaries to the Sacramento River, and the Delta. Juvenile spring-run are most abundant in the Delta in late winter and early spring as fry, but are captured in significant numbers as larger juveniles in late spring as well, and in small numbers as larger juveniles in late summer and fall (Williams 2006).

The 2008 Amendment conservation actions in the Yolo Bypass, Delta and Suisun Marsh may result in short-term adverse effects to outmigrating juveniles. However, because these projects will restore and enhance habitat conditions for outmigrants in the long-term, these projects will not jeopardize the continued existence of the species and will not adversely modify designated critical habitat. On the contrary, these conservation actions will have a net benefit to the species, helping to contribute to its recovery.

The 2008 Amendment conservation actions in Battle Creek, Mill Creek, Butte Creek, and the Feather River may result in short-term adverse effects to spring-run Chinook salmon. Such effects may include short-term mortality, reduced reproductive success, and reduced growth rates as a result of physical disturbance, noise, sedimentation, and accidental spills of chemicals or materials during project activities, as well as the release of sediments stored behind dams that are to be removed in the Battle Creek watershed. However, since these projects will restore and enhance habitat conditions, they will not jeopardize the continued existence of the species and will not adversely modify designated critical habitat. On the contrary, these conservation actions will provide net benefits to spring-run Chinook salmon and contribute to its recovery. The Spring-run Warden Overtime project will provide protection to holding adult spring-run Chinook

salmon in all of their spawning tributaries, which should decrease risk of mortality due to poaching or other illegal activities and provide a net benefit.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for aquatic species and habitat quality, and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating).

Potential effects of the 2008 Amendment actions on spring-run Chinook salmon and designated critical habitat are described below.

Habitat Modification

NMFS (2008a) has identified spring-run Chinook salmon priority recovery actions that include access to habitat above dams, especially on Battle Creek; small hydropower dams and water diversions on their natal tributaries that reduce or eliminate instream flows during spring-run migration periods, leading to predation by non-native species and excessively high water temperatures; and loss of fish attributed to unscreened or inadequately screened water diversions in migratory corridors.

The 2008 Amendment conservation actions include the following projects in tributaries that are designed to provide benefits to habitat for adult spawning and juvenile rearing and outmigrating spring-run Chinook salmon:

- Battle Creek restoration of access to habitat suitable for spring-run Chinook salmon that will be beneficial for the recovery of the ESU. Short-term mortality, reduced reproductive success, and reduced growth rates may occur as a result of physical disturbance, noise, sedimentation, and accidental spills of chemicals or materials during project activities, as well as the release of sediments stored behind dams that are to be removed in the Battle Creek watershed. However, such adverse effects will be short-term and limited compared to the overwhelming benefits of the project.
- Butte Creek operations and maintenance of the Parrott Phelan and Durham Mutual Dam fish ladders and screens to aid upstream and downstream migration of spring-run Chinook salmon. The Butte Creek spring-run Chinook salmon contribution makes up better than half of the entire Central Valley spring-run Chinook population. These fish ladders have improved salmon survival by allowing adult spawners to pass upstream during low water periods, through the quick passage of salmon progeny downstream and by decreased injury of adults during all water years. Consistent and timely maintenance and operation of these screens provides a net benefit for the ESU.
- Deer Creek Flow Enhancement Program's water exchange project intended to provide salmonid passage flows for adult spawners and juvenile outmigrants. The project would improve access by salmonids to and from approximately 25 miles of Deer Creek upstream from the Sanford Vina Diversion Dam. The main components of the program include development of supplemental water supply, implementation of agricultural water use efficiency improvements, and the incorporation of groundwater monitoring and fish

passage assessment monitoring. These actions will be beneficial to recovery of spring-run Chinook salmon.

- Mill Creek Water Exchange Program to provide salmonid passage flows for adult spawners and juvenile outmigrants, primarily on the lower reach of Mill Creek, roughly from the east side of the Sacramento Valley floor downstream to its confluence with the Sacramento River, north of Los Molinos in Tehama County. The water exchange project on Mill Creek provides for new wells that enable irrigators to switch from stream flow to groundwater, thus leaving water in the creeks during critical spring and fall migration periods and allowing salmonids to access up to 35 miles of spawning and rearing habitat. Mill Creek, a tributary of the Upper Sacramento River, is one of only a few waterways in the Central Valley that continue to support native populations of wild spring-run salmon. Upper reaches of the creek provide 35 miles of ideal holding and spawning habitat -- undercut banks, deep pools, and cold springs. In recent years the spring-run population in Mill Creek has dwindled to a few hundred adults in contrast to an average of 2000 in the 1950s. A key factor that limits the population in some years is the lack of sufficient water for passage to upstream habitat. Supplemental flows will help restore the population of wild spring-run Chinook by allowing migrating adults to reach their spawning habitat and by providing transportation flows for juveniles en route to the Sacramento River and be beneficial to recovery of spring-run Chinook salmon.

Although the timing of juvenile spring-run outmigration through the Delta is known based on existing monitoring, specific habitats utilized by outmigrating spring-run are poorly understood. Specific information on what is known about salmonid use of the Delta is:

- Juvenile Chinook salmon rear in the estuary but use of specific habitat types is not well known, as most evaluations have been conducted using beach seines which do not sample efficiently in vegetation or on rock/rip-rap substrates, and in water >1m deep (California Department of Water Resources Interagency Ecological Program 2006).
- Growth rates appear to be relatively slow during outmigration when compared to other salmonids in other estuary systems (MacFarlane and Norton 2002).
- Juvenile Chinook salmon feed predominantly on chironomid larvae and pupae (more typical of emergent marsh) as well as the amphipod *Hyallela azteca* and tend to occur in more “open water” than in association with submerged vegetation (Williams 2006, Simenstad *et al.* 2000).
- Water temperatures >15°C tend to favor non-native fish assemblages (CALFED Bay Delta Science Program 2001, California Department of Water Resources Interagency Ecological Program 2006).
- Seasonally inundated floodplain habitat (*e.g.*, Yolo Bypass) provides important rearing habitat enhancing growth and survival of outmigrating juvenile Chinook salmon (Sommer *et al.* 2001, Sommer *et al.* 2005), although stranding can occur associated with engineered water control structures such as weirs (Sommer *et al.* 2005).

The 2008 Amendment conservation actions in the Yolo Bypass, western Delta, and Suisun Marsh will improve survival and growth of juvenile spring-run Chinook salmon by increasing and improving floodplain and estuarine rearing and outmigration habitat. Juvenile Chinook salmon should benefit from projects to improve connectivity and reduce stranding risk associated with engineered weirs in the Yolo Bypass, such as the Lisbon weir improvements, additional multi-species floodplain habitat development improvements, Tule Canal conductivity improvements, and Fremont Weir fish passage improvements. The 2008 Amendment conservation actions in estuarine habitat used by juvenile spring-run Chinook salmon, including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex, and restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh, will consist of tidal restoration projects that are expected to be beneficial. Habitat quality is expected to increase by increasing tidally inundated shallow water habitat and marsh ecotones, thus improving the food base and habitat conditions for juvenile rearing and outmigration. Potential short-term adverse effects may occur associated with grading, excavation, placement of fill for levees or berms, and movement of heavy equipment and vehicles, which could result in increased turbidity and suspended sediment, as well as potentially resulting in toxic spills. However, BMPs will be implemented to minimize or avoid any such adverse effects. Potential short-term effects such as increased turbidity and suspended sediment may also occur following breaching of levees during early stages of flooding, until aquatic food webs can establish and initial erosion has occurred; however, BMPs to limit breaching to times of year when target fish species are not present should minimize or avoid any such adverse effects. In addition, there is some evidence that increased turbidity can moderate effects of predation on juvenile salmonids (Nobriga *et al.* 2005).

The 2008 Amendment conservation actions in estuarine habitat used by juvenile spring-run Chinook salmon, including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex, and restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh potentially could result in poor water quality conditions for juvenile spring-run, such as low dissolved oxygen and contaminants, and could provide habitat for non-native aquatic plants and predatory fish species. However, Aquatic and Wetland Species/Water Quality BMPs will be implemented to minimize or avoid any such adverse effects. Given that the projects will result in full tidal circulation, it is unlikely that dissolved oxygen levels will adversely affect juvenile spring-run. The effects of such tidal restoration on mercury methylation are difficult to predict, but some accumulation of mercury in the food web could occur (Brown 2003). Invasive aquatic plant species (*e.g.*, Brazilian waterweed and water hyacinth) have been documented to provide habitat for non-native fish species over native fish species (Brown 2003). Efforts to restore tidal wetland and subtidal habitats will need to consider approaches to minimize the risk of invasion of non-native aquatic plant species (Brown 2003). In addition, water quality, non-native aquatic plants, and non-native predatory fish species will be monitored and addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Non-native fish are commonly distributed in the Yolo Bypass, the Delta, and Suisun Marsh (Nobriga *et al.* 2005, Feyrer and Healey 2003, Feyer *et al.* 2006; Matern *et al.* 2002; Simenstad *et al.* 2000), although the highest proportions of native fish species occur in the northern Delta (Brown and Michniuk 2007). Many of the non-native species, such as largemouth bass and striped bass, are known predators on smaller fish such as juvenile salmonids. The 2008 Amendment conservation actions identified in the Yolo Bypass, the Delta, and Suisun Marsh are likely to provide habitat for these predatory non-native fish species; however, juvenile salmonids are most likely to occur in the restoration sites in the winter and spring when water temperature is at its coldest, which will decrease the potential for overlap between non-native predators and native fish. One of the goals of the conservation actions will be to limit the type of habitat used by non-native fish predators, thereby potentially reducing predation. Non-native predatory fish species will be monitored and addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Effects on Central Valley Spring-run Chinook Salmon Critical Habitat

The effects of diversions and entrainment of spring-run Chinook salmon by operational aspects of the OCAP are discussed in sections of this biological assessment pertaining to pump operations. The following section focuses on the effects (overwhelmingly beneficial) of the 2008 Amendment conservation actions on spring-run Chinook salmon.

Designated critical habitat for spring-run Chinook salmon includes watershed habitat areas that include approximately 1373 mi (2197 km) of occupied stream habitat and approximately 427 mi^2 (1102 km^2) of estuarine habitat in the San Francisco-San Pablo-Suisun Bay complex (NMFS 2005). PCEs relative to the 2008 Amendment conservation actions for spring-run Chinook salmon are:

- Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development.
- Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.
- Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.
- Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

All of the 2008 Amendment conservation actions in tributaries as described above are within designated critical habitat. Projects on Battle Creek, Mill Creek, Butte Creek, and Deer Creek may result in short-term adverse effects to spring-run Chinook salmon habitat as a result of physical disturbance, noise, sedimentation, and accidental spills of chemicals or materials during project activities, as well as the release of sediments stored behind dams that are to be removed in the Battle Creek watershed. However, these projects are designed to improve upstream and downstream passage for adults and juveniles, and holding and spawning habitat for adults, and the net effect of these projects will be overwhelming improvements to habitat conditions within tributary streams designated as critical habitat for spring-run Chinook salmon.

The 2008 Amendment conservation actions in the Yolo Bypass are designed to improve connectivity within the bypass; these projects include the Lisbon weir improvements, additional multi-species floodplain habitat development improvements, Tule Canal conductivity improvements, and Fremont Weir fish passage improvements. Currently, the Yolo Bypass is known to provide important habitat for outmigrating juvenile Chinook salmon although there is a risk of stranding; the proposed improvements will decrease the risk of stranding of juvenile spring-run.

The 2008 Amendment conservation actions in the Delta and Suisun Marsh will restore tidal circulation and tidal marsh, as is proposed for the western Cache Slough Complex and Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex and the Hill Slough West Tidal Marsh Restoration project. The evolution of tidal marsh habitat will occur over time, with potential for some initial short-term adverse effects to designated critical habitat until conditions equilibrate. These short-term effects are likely to include short-term increases in turbidity associated with initial breaching. Potential longer term effects to designated critical habitat, such as low dissolved oxygen, contaminants, mercury accumulation in the food web, or invasion by non-native aquatic plants, will be monitored and addressed in the Adaptive Management Plan. In the long-term, the fully tidal marshes that will be restored are likely to provide essential foraging habitat and food resources used by juvenile spring-run; monitoring and adaptive management described in the Adaptive Management Plan will be used to evaluate and modify projects to make sure that the projects will not adversely modify critical habitat and will instead contribute to the recovery of spring-run Chinook salmon.

Effects on Delta Smelt

The effects of diversions and entrainment of delta smelt by operational aspects of the OCAP are discussed in sections of this biological assessment pertaining to pump operations. The following section focuses on the effects (overwhelmingly beneficial) of the 2008 Amendment conservation actions on delta smelt.

The 2008 Amendment conservation action to establish a temporary delta smelt refugium at Byron by June 2008 is designed to provide immediate conservation of the genetic diversity and continued survival of delta smelt, and is identified in the Resources Agency's Pelagic Fish Action Plan (March 2007).

The 2008 Amendment conservation actions in the Delta and Suisun Marsh may result in short-term adverse effects to delta smelt. However, because these projects will restore and enhance habitat conditions for delta smelt in the long-term, these projects will not jeopardize the continued existence of the species and will not adversely modify designated critical habitat. On the contrary, these conservation actions will have a net benefit to the species, helping to contribute to its recovery.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for aquatic species and habitat quality and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating).

Potential effects of the 2008 Amendment actions on delta smelt and designated critical habitat are described below.

Habitat Modification

Delta smelt spawn in the freshwater reaches of the Delta; most ripe females and yolk-sac larvae are found in the Sacramento River, particularly around Prospect Island and the Barker-Lindsey Slough complex, in years of low freshwater discharge, and in Suisun Marsh channels, the Napa River, and most of the Delta in years of high freshwater discharge (Bennett 2005). Actual spawning locations and spawning habitat are not known as eggs have not been found in the field; it is also not known if spawning habitat is limiting production (Bennett 2005). Summer habitat characteristics associated with delta smelt relative abundance include specific conductance, Secchi disk depth, and water temperature, but only at regional spatial scales (Nobriga *et al.* 2008).

The 2008 Amendment conservation actions in the western Delta and Suisun Marsh will provide habitat for spawning and rearing, and improve survival and growth of delta smelt by increasing and improving estuarine habitat in areas known to be used by delta smelt. The proposed actions, including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex, and restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh, will consist of tidal restoration projects that are expected to be beneficial. The 2008 Amendment conservation actions in the Delta and Suisun Marsh will restore tidal circulation and tidal marsh to 8047 to 12,076 acres of habitat for delta smelt in the western Delta, where spawning delta smelt are known to occur, substantially increasing habitat for delta smelt over existing channelized habitat. Anticipated outcomes of this extensive restoration are: (1) a mosaic of evolving habitats supporting numerous species at a significant scale; (2) increased connectivity to the Yolo Bypass, Sacramento River, and Suisun Marsh; (3) increased food supply for fish, birds, marine mammals; (4) landward migration of intertidal marsh over time; (5) reduced water treatment needs; and (6) improved hydraulics so fish can reach habitats and primary production can reach the Sacramento River. Large quantities of plankton and detritus produced by the tidally influenced wetlands would support forage on-site as well as within the Sacramento-San Joaquin Delta (via tidal action transport). Relevant to delta smelt, the projects will create habitats supporting the pelagic food web in an adaptive approach that takes into

account the physical processes (tidal circulation, mixing, inflow, exports, residence time, connectivity) and biological processes (primary production, competition, predation, invasive species) for restoring Delta habitats (Lucas *et al.* 2002, Kimmerer and Nobriga 2008).

Habitat quality is expected to increase by increasing tidally inundated shallow water habitat and marsh ecotones, thus improving the food base and habitat conditions for spawning and rearing. Potential short-term adverse effects may occur associated with grading, excavation, placement of fill for levees or berms, and movement of heavy equipment and vehicles, which could result in increased turbidity and suspended sediment, as well as potentially resulting in toxic spills. However, BMPs will be implemented to minimize or avoid any such adverse effects. Potential short-term effects such as increased turbidity and suspended sediment may also occur following breaching of levees during early stages of flooding, until aquatic food webs can establish and initial erosion has occurred; however, BMPs to limit breaching to times of year when delta smelt are not spawning should minimize or avoid any such adverse effects. In addition, there is some evidence that increased turbidity positively affects delta smelt abundance, perhaps by moderating effects of predation (Nobriga *et al.* 2008).

The 2008 Amendment conservation actions in estuarine habitat used by delta smelt, including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex, and restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh potentially could result in poor water quality conditions for delta smelt, such as low dissolved oxygen and contaminants, and could provide habitat for non-native aquatic plants and predatory fish species. However, Aquatic and Wetland Species/Water Quality BMPs will be implemented to minimize or avoid any such adverse effects. Given that the projects will result in full tidal circulation, it is unlikely that dissolved oxygen levels will adversely affect delta smelt. The effects of such tidal restoration on mercury methylation are difficult to predict, but some accumulation of mercury in the food web could occur (Brown 2003). Invasive aquatic plant species (*e.g.*, Brazilian waterweed and water hyacinth) have been documented to provide habitat for non-native fish species over native fish species (Brown 2003). Efforts to restore tidal wetland and subtidal habitats will need to consider approaches to minimize the risk of invasion of non-native aquatic plant species (Brown 2003). In addition, water quality, non-native aquatic plants, and non-native predatory fish species will be monitored and addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Non-native fish are commonly distributed in the Delta and Suisun Marsh (Nobriga *et al.* 2005, Feyrer and Healey 2003, Feyer *et al.* 2006; Matern *et al.* 2002; Simenstad *et al.* 2000), although the highest proportions of native fish species occur in the northern Delta (Brown and Michniuk 2007). Many of the non-native species, such as largemouth bass and striped bass, are known predators on smaller fish such as delta smelt. The 2008 Amendment conservation actions identified in the Delta and Suisun Marsh are likely to provide habitat for these predatory non-native fish species; however, spawning delta smelt are most likely to occur in the restoration sites in the winter and spring when water temperature is at its coldest, which will decrease the potential for overlap between non-native predators and native fish. One of the goals of the conservation actions will be to limit the type of habitat used by non-native fish predators, thereby potentially reducing predation. Non-native predatory fish species will be monitored and

addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Loss of Individuals

The refugium facilities will need to use 1000 smelt that UCD has already collected as the refugium's founding stock. UCD originally collected these fish to spawn and produce fish for various research purposes. Their reallocation to the refugium would substantially reduce the number of additional smelt which would need to be collected from the Delta to stock the refugium. CDFG and USFWS are trying to minimize the collection of additional smelt from the Delta because of the impact it may have on the already low population.

CDWR is working with the USFWS and UCD through the USFWS's Delta Smelt Captive Propagation Work Group to establish a permanent smelt refugium to ensure the conservation of the genetic diversity of delta smelt. The refugium would provide the brood stock for a conservation hatchery if and when the state and federal fishery agencies decide it is needed to supplement the remaining wild population of delta smelt or to restock the Delta if the wild population is extirpated. This facility is using wild-born smelt collected in 2006 as its initial founding stock.

Effects on Delta Smelt Critical Habitat

Critical habitat was designated to include waters of Suisun Bay and the Delta (USFWS 1994). The PCEs of designated critical habitat include:

- Spawning habitat including shallow, fresh or slightly brackish backwater sloughs and edgewaters for spawning, with suitable water quality (*i.e.*, low concentrations of pollutants) and substrates for egg attachment (*e.g.*, submerged tree roots and branches and emergent vegetation) in Barker, Lindsey, Cache, Prospect, Georgiana, Beaver, Hog, and Sycamore Sloughs and the Sacramento River in the Delta, and tributaries of northern Suisun Bay.
- Conditions for larval and juvenile transport from where they hatch to shallow, productive rearing and nursery habitat protected from physical disturbance and flow disruption.
- Rearing habitat of suitable salinity and water quality in shallow, productive, food-rich estuarine environments.
- Adult migration habitat with unrestricted access to spawning habitat with suitable water quality conditions and protected from flow or physical disturbance. Cache and Montezuma Sloughs and their tributaries were specifically identified.

The 2008 Amendment conservation actions proposed in the Delta (including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex) and the Suisun Marsh (including restoration of tidal marsh at Hill Slough West and Meins Landing) are within designated critical habitat.

The 2008 Amendment conservation actions in the Delta and Suisun Marsh will restore tidal circulation and tidal marsh to 8047 to 12,076 acres of habitat for delta smelt in the western Delta, where spawning delta smelt are known to occur, substantially increasing habitat for delta smelt over existing channelized habitat. These projects will increase the quantity and improving the quality of habitat for larval rearing and adult migration and spawning. The evolution of tidal marsh habitat will occur over time, with potential for some initial short-term adverse effects to designated critical habitat until conditions equilibrate. These short-term effects are likely to include short-term increases in turbidity associated with initial breaching. Potential longer term effects to designated critical habitat, such as low dissolved oxygen, contaminants, mercury accumulation in the food web, or invasion by non-native aquatic plants, will be monitored and addressed in the Adaptive Management Plan. In the long-term, the fully tidal marshes that will be restored are likely to provide essential spawning and rearing habitat with food resources used by delta smelt; monitoring and adaptive management described in the Adaptive Management Plan will be used to evaluate and modify projects to make sure that the projects will not adversely modify critical habitat and will contribute to the recovery of delta smelt.

Effects on Longfin Smelt

The effects of diversions and entrainment of longfin smelt by operational aspects of the OCAP are discussed in sections of this biological assessment pertaining to pump operations. The following section focuses on the effects (overwhelmingly beneficial) of the 2008 Amendment conservation actions on longfin smelt.

Adult longfin smelt aggregate in Suisun Bay and the western Delta in late fall and spawn in freshwater habitats just upstream in winter and spring (Rosenfield and Baxter 2007). Longfin smelt use open water habitat, away from shorelines and vegetated inshore areas except perhaps during spawning; these habitats include large embayments, such as Suisun Bay and deeper areas of larger Delta channels with suitable water quality characteristics and high levels of production to support growth.

The 2008 Amendment conservation actions in the Delta and Suisun Marsh may result in short-term adverse effects to longfin smelt. However, because these projects will restore and enhance habitat conditions that will provide nutrients and food resources for longfin smelt in the long-term, these projects will not jeopardize the continued existence of the species. On the contrary, these conservation actions will have a net benefit to the species, helping to contribute to its recovery.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for aquatic species and habitat quality and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating).

Critical habitat has not been designated for the longfin smelt. Potential effects of the 2008 Amendment actions on longfin smelt are described below.

Habitat Modification

Longfin smelt spawn primarily in the freshwater reaches of the Delta generally downstream of Rio Vista on the Sacramento River and downstream of Medford Island on the San Joaquin River to an area just downstream of the confluence of the San Joaquin and Sacramento Rivers. Population declines are thought to be due to a number of factors, including changes in primary and secondary production (bottom up effects), entrainment and predation (top down effects), habitat, and prior abundance.

The 2008 Amendment conservation actions in the western Delta and Suisun Marsh will provide indirect benefits for juvenile and adult longfin smelt by providing productivity to the Delta that is anticipated to improve survival and growth of longfin smelt. The proposed actions, including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex, and restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh, will consist of tidal restoration projects that are expected to be beneficial. Habitat quality is expected to increase by increasing tidally inundated shallow water habitat and marsh ecotones, thus improving the food base and habitat conditions for juvenile and adult longfin smelt that live in habitats downstream of the project area. Potential short-term adverse effects may occur associated with grading, excavation, placement of fill for levees or berms, and movement of heavy equipment and vehicles, which could result in increased turbidity and suspended sediment, as well as potentially resulting in toxic spills. However, BMPs will be implemented to minimize or avoid any such adverse effects. Potential short-term effects such as increased turbidity and suspended sediment may also occur following breaching of levees during early stages of flooding, until aquatic food webs can establish and initial erosion has occurred; however, BMPs to limit breaching to times of year when longfin smelt are spawning should minimize or avoid any such adverse effects.

The 2008 Amendment conservation actions in estuarine habitat adjacent to open waters used by longfin smelt, including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex, and restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh potentially could result in poor water quality conditions for longfin smelt, such as low dissolved oxygen and contaminants, and could provide habitat for non-native aquatic plants and predatory fish species. However, Aquatic and Wetland Species/Water Quality BMPs will be implemented to minimize or avoid any such adverse effects. Given that the projects will result in full tidal circulation, it is unlikely that dissolved oxygen levels will adversely affect longfin smelt. The effects of such tidal restoration on mercury methylation are difficult to predict, but some accumulation of mercury in the food web could occur (Brown 2003). Invasive aquatic plant species (*e.g.*, Brazilian waterweed and water hyacinth) have been documented to provide habitat for non-native fish species over native fish species (Brown 2003). Efforts to restore tidal wetland and subtidal habitats will need to consider approaches to minimize the risk of invasion of non-native aquatic plant species (Brown 2003). In addition, water quality, non-native aquatic plants, and non-native predatory fish species will be monitored and addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Non-native fish are commonly distributed in Delta and Suisun Marsh (Nobriga *et al.* 2005, Feyrer and Healey 2003, Feyer *et al.* 2006; Matern *et al.* 2002; Simenstad *et al.* 2000), although the highest proportions of native fish species occur in the northern Delta (Brown and Michniuk 2007). Many of the non-native species, such as largemouth bass and striped bass, are known predators on smaller fish such as longfin smelt. The 2008 Amendment conservation actions identified in the Delta and Suisun Marsh are likely to provide habitat for these predatory non-native fish species; however, longfin smelt are not likely to occur in the restoration sites as their primary habitat is open water downstream of the projects. One of the goals of the conservation actions will be to limit the type of habitat used by non-native fish predators, thereby potentially reducing predation. Non-native predatory fish species will be monitored and addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Effects on California Central Valley Steelhead

The effects of diversions and entrainment of California Central Valley steelhead by operational aspects of the OCAP are discussed in sections of this biological assessment pertaining to pump operations. The following section focuses on the effects (overwhelmingly beneficial) of the 2008 Amendment conservation actions on California Central Valley steelhead.

California Central Valley steelhead populations once occupied the headwaters of all major river systems in the Central Valley up to any natural barrier (Lindley *et al.* 2006); these fish have lost access to a substantial amount (about 80%) of their original habitat due to dam construction. California Central Valley steelhead are now primarily restricted to a few remaining free-flowing tributaries and to stream reaches below large dams, although a few individuals may also spawn in intermittent streams during wet years. Naturally spawning California Central Valley steelhead populations have been found in the upper Sacramento River and tributaries below Keswick Dam, Mill, Deer, and Butte creeks, and the Feather, Yuba, American, and Mokelumne Rivers. Juveniles rear for 1-3 years in natal tributaries, the mainstem Sacramento River, nonnatal tributaries to the Sacramento River, and the Delta. The Delta serves as an adult and juvenile migration corridor connecting inland habitat to the ocean. The Delta may also serve as a nursery area for juvenile California Central Valley steelhead; estuaries are important nursery grounds for other coastal steelhead populations, including the Central California Coast steelhead discussed below. However, the historical and current role of the Delta as a nursery habitat for California Central Valley steelhead is unknown. Based on fish facility salvage data, most California Central Valley steelhead move through the Delta from November through June with the peak salvage occurring during February, March, and April.

The 2008 Amendment conservation actions in the Yolo Bypass, Delta, and Suisun Marsh may result in short-term adverse effects to outmigrating juveniles. However, because these projects will restore and enhance habitat conditions for outmigrants in the long-term, these projects will not jeopardize the continued existence of the species and will not adversely modify designated critical habitat. On the contrary, these conservation actions will have a net benefit to the species, helping to contribute to its recovery.

The 2008 Amendment conservation actions in Battle Creek, Mill Creek, Butte Creek, and the Feather River may result in short-term adverse effects to California Central Valley steelhead. Such effects may include short-term mortality, reduced reproductive success, and reduced growth rates as a result of physical disturbance, noise, sedimentation, and accidental spills of chemicals or materials during project activities, as well as the release of sediments stored behind dams that are to be removed in the Battle Creek watershed. However, since these projects will restore and enhance habitat conditions, they will not jeopardize the continued existence of the species and will not adversely modify designated critical habitat. On the contrary, these conservation actions will provide net benefits to the California Central Valley steelhead and contribute to its recovery.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for aquatic species and habitat quality, and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating).

Potential effects of the 2008 Amendment actions on the California Central Valley steelhead and designated critical habitat are described below.

Habitat Modification

NMFS (2008b) has identified California Central Valley steelhead priority recovery actions that include access to habitat above dams, especially on Battle Creek; small hydropower dams and water diversions on their natal tributaries that reduce or eliminate instream flows during spring-run migration periods, leading to predation by non-native species and excessively high water temperatures; and loss of fish attributed to unscreened or inadequately screened water diversions in migratory corridors.

The 2008 Amendment conservation actions include the following projects in tributaries that are designed to provide benefits to habitat for adult spawning and juvenile rearing and outmigrating California Central Valley steelhead:

- Battle Creek restoration of access to habitat suitable for California Central Valley steelhead that will be beneficial for the recovery of the ESU. Short-term mortality, reduced reproductive success, and reduced growth rates may occur as a result of physical disturbance, noise, sedimentation, and accidental spills of chemicals or materials during project activities, as well as the release of sediments stored behind dams that are to be removed in the Battle Creek watershed. However, such adverse effects will be short-term and limited compared to the overwhelming benefits of the project.
- Butte Creek operations and maintenance of the Parrott Phelan and Durham Mutual Dam fish ladders and screens to aid upstream and downstream migration of California Central Valley steelhead. These fish ladders have improved survival by allowing adult spawners to pass upstream during low water periods, through the quick passage of progeny downstream, and by decreased injury of adults during all water years. Consistent and timely maintenance and operation of these screens provides a net benefit for the ESU.

- Deer Creek Flow Enhancement Program's water exchange project intended to provide California Central Valley steelhead passage flows for adult spawners and juvenile outmigrants. The project would improve access by this species to and from approximately 25 miles of Deer Creek upstream from the Sanford Vina Diversion Dam. The main components of the program include development of supplemental water supply, implementation of agricultural water use efficiency improvements, and the incorporation of groundwater monitoring and fish passage assessment monitoring. These actions will be beneficial to recovery of California Central Valley steelhead.
- Mill Creek Water Exchange Program to provide passage flows for adult spawners and juvenile outmigrants, primarily on the lower reach of Mill Creek, roughly from the east side of the Sacramento Valley floor downstream to its confluence with the Sacramento River, north of Los Molinos in Tehama County. The water exchange project on Mill Creek provides for new wells that enable irrigators to switch from stream flow to groundwater, thus leaving water in the creeks during critical spring and fall migration periods and allowing California Central Valley steelhead to access up to 35 miles of spawning and rearing habitat. Upper reaches of the creek provide 35 miles of ideal holding and spawning habitat -- undercut banks, deep pools, and cold springs. Supplemental flows will help restore the population of wild California Central Valley steelhead by allowing migrating adults to reach their spawning habitat and by providing transportation flows for juveniles en route to the Sacramento River, and be beneficial to recovery of this species.

Although the timing of juvenile California Central Valley steelhead outmigration through the Delta is known based on information from the fish facility salvage data, specific habitats utilized by outmigrating individuals are not understood. Although there is no specific information on California Central Valley steelhead habitat use in the Delta, it is likely that juveniles could use similar habitats as Chinook salmon for outmigration and rearing. The primary difference between California Central Valley steelhead and Chinook salmon is that steelhead are likely to be in the Delta as very large juveniles (compared to Chinook salmon). Based on fish facility salvage data, juvenile California Central Valley steelhead range from 175-325 mm, with the most common size in the 226-250 mm range, whereas the majority of juvenile Chinook salmon range approximately from 50-200 mm (Williams 2006). Specific information on what is known about salmonid use of the Delta is:

- Juvenile Chinook salmon rear in the estuary but use of specific habitat types is not well known, as most evaluations have been conducted using beach seines which do not sample efficiently in vegetation or on rock/rip-rap substrates, and in water >1m deep (California Department of Water Resources Interagency Ecological Program 2006).
- Growth rates appear to be relatively slow during outmigration when compared to other salmonids in other estuary systems (MacFarlane and Norton 2002).
- Juvenile Chinook salmon feed predominantly on chironomid larvae and pupae (more typical of emergent marsh) as well as the amphipod *Hyallela azteca* and tend to occur in

more "open water" than in association with submerged vegetation (Williams 2006, Simenstad *et al.* 2000).

- Water temperatures >15°C tend to favor non-native fish assemblages (CALFED Bay Delta Science Program 2001, California Department of Water Resources Interagency Ecological Program 2006).
- Seasonally inundated floodplain habitat (*e.g.*, Yolo Bypass) provides important rearing habitat enhancing growth and survival of outmigrating juvenile Chinook salmon (Sommer *et al.* 2001, Sommer *et al.* 2005), although stranding can occur associated with engineered water control structures such as weirs (Sommer *et al.* 2005).

The 2008 Amendment conservation actions in the Yolo Bypass, western Delta, and Suisun Marsh will improve survival and growth of juvenile California Central Valley steelhead by increasing and improving floodplain and estuarine rearing and outmigration habitat. Juveniles should benefit from projects to improve connectivity and reduce stranding risk associated with engineered weirs in the Yolo Bypass, such as the Lisbon weir improvements, additional multi-species floodplain habitat development improvements, Tule Canal conductivity improvements, and Fremont Weir fish passage improvements. The 2008 Amendment conservation actions in estuarine habitat used by juvenile California Central Valley steelhead, including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex, and restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh, will consist of tidal restoration projects that are expected to be beneficial. Habitat quality is expected to increase by increasing tidally inundated shallow water habitat and marsh ecotones, thus improving the food base and habitat conditions for juvenile rearing and outmigration. Potential short-term adverse effects may occur associated with grading, excavation, placement of fill for levees or berms, and movement of heavy equipment and vehicles, which could result in increased turbidity and suspended sediment, as well as potentially resulting in toxic spills. However, BMPs will be implemented to minimize or avoid any such adverse effects. Potential short-term effects such as increased turbidity and suspended sediment may also occur following breaching of levees during early stages of flooding, until aquatic food webs can establish and initial erosion has occurred; however, BMPs to limit breaching to times of year when target fish species are not present should minimize or avoid any such adverse effects. In addition, there is some evidence that increased turbidity can moderate effects of predation on juvenile salmonids (Nobriga *et al.* 2005).

The 2008 Amendment conservation actions in estuarine habitat used by juvenile California Central Valley steelhead, including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex, and restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh potentially could result in poor water quality conditions for juveniles, such as low dissolved oxygen, contaminants, mercury accumulation in the food web, and could provide habitat for non-native aquatic plants and predatory fish species. However, Aquatic and Wetland Species/Water Quality BMPs will be implemented to minimize or avoid any such adverse effects. Given that the projects will result

in full tidal circulation, it is unlikely that dissolved oxygen levels will adversely affect juvenile California Central Valley steelhead. Invasive aquatic plant species (*e.g.*, Brazilian waterweed and water hyacinth) have been documented to provide habitat for non-native fish species over native fish species (Brown 2003). Efforts to restore tidal wetland and subtidal habitats will need to consider approaches to minimize the risk of invasion of non-native aquatic plant species (Brown 2003). In addition, water quality, non-native aquatic plants, and non-native predatory fish species will be monitored and addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Non-native fish are commonly distributed in the Yolo Bypass, the Delta, and Suisun Marsh (Nobriga *et al.* 2005, Feyrer and Healey 2003, Feyer *et al.* 2006; Matern *et al.* 2002; Simenstad *et al.* 2000), although the highest proportions of native fish species occur in the northern Delta (Brown and Michniuk 2007). Many of the non-native species, such as largemouth bass and striped bass, are known predators on smaller fish such as juvenile California Central Valley steelhead. The 2008 Amendment conservation actions identified in the Yolo Bypass, the Delta, and Suisun Marsh are likely to provide habitat for these predatory non-native fish species; however, juvenile California Central Valley steelhead are most likely to occur in the restoration sites in the winter and spring when water temperature is at its coldest, which will decrease the potential for overlap between non-native predators and native fish. One of the goals of the conservation actions will be to limit the type of habitat used by non-native fish predators, thereby potentially reducing predation. Non-native predatory fish species will be monitored and addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Effects on California Central Valley Steelhead Critical Habitat

The effects of diversions and entrainment of California Central Valley steelhead by operational aspects of the OCAP are discussed in sections of this biological assessment pertaining to pump operations. The following section focuses on the effects (overwhelmingly beneficial) of the 2008 Amendment conservation actions on California Central Valley steelhead critical habitat.

Designated critical habitat for this species includes watershed habitat areas that include approximately 2604 mi (4,168 km) of stream habitat and approximately 427 mi^2 (1,102 km^2) of estuarine habitat in the San Francisco-San Pablo-Suisun Bay complex (NMFS 2005). PCEs relevant to the 2008 Amendment conservation actions for California Central Valley steelhead are:

- Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development.
- Freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

- Freshwater migration corridors free of obstruction with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.
- Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

All of the 2008 Amendment conservation actions in tributaries as described above are within designated critical habitat. Projects on Battle Creek, Mill Creek, Butte Creek, and Deer Creek may result in short-term adverse effects to California Central Valley steelhead habitat as a result of physical disturbance, noise, sedimentation, and accidental spills of chemicals or materials during project activities, as well as the release of sediments stored behind dams that are to be removed in the Battle Creek watershed. However, these projects are designed to improve upstream and downstream passage for adults and juveniles, and holding and spawning habitat for adults, and the net effect of these projects will be overwhelming improvements to habitat conditions within tributary streams designated as critical habitat for California Central Valley steelhead.

The 2008 Amendment conservation actions in the Yolo Bypass are designed to improve connectivity within the bypass; these include actions such as the Lisbon weir improvements, additional multi-species floodplain habitat development improvements, Tule Canal conductivity improvements, and Fremont Weir fish passage improvements. Currently, the Yolo Bypass may provide important habitat for outmigrating juvenile California Central Valley steelhead although there is a risk of stranding; the proposed improvements will decrease the risk of stranding of juveniles.

The 2008 Amendment conservation actions in the Delta and Suisun Marsh will restore tidal circulation and tidal marsh, as is proposed for the restoration of the western Cache Slough Complex and Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex and the Hill Slough West Tidal Marsh Restoration project. The evolution of tidal marsh habitat will occur over time, with potential for some initial short-term adverse effects to designated critical habitat until conditions equilibrate. These short-term effects are likely to include short-term increases in turbidity associated with initial breaching. Potential longer term effects to designated critical habitat, such as low dissolved oxygen, contaminants, accumulation of mercury in the food web, or invasion by non-native aquatic plants, will be monitored and addressed in the Adaptive Management Plan. In the long-term, the fully tidal marshes that will be restored are likely to provide essential foraging habitat and food resources used by juvenile California Central Valley steelhead; monitoring and adaptive management described in the Adaptive Management Plan will be used to evaluate and modify projects to make sure that the projects will not adversely modify critical habitat and will instead contribute to the recovery of California Central Valley steelhead.

Effects on Central California Coast Steelhead

The potential effects of the OCAP's operational components on Central California Coast steelhead are discussed in sections of this biological assessment pertaining to pump operations. The following section focuses on the potential effects (primarily beneficial) of the 2008 Amendment conservation actions on Central California Coast steelhead.

NMFS (2006) defined the Central California Coast steelhead Distinct Population Segment as including "all naturally spawned populations of steelhead in coastal streams from the Russian River (inclusive) to Aptos Creek (inclusive), and the drainages of San Francisco, San Pablo, and Suisun Bays eastward to Chipps Island at the confluence of the Sacramento and San Joaquin Rivers; and tributary streams to Suisun Marsh including Suisun Creek, Green Valley Creek, and an unnamed tributary to Cordelia Slough (commonly referred to as Red Top Creek), exclusive of the Sacramento-San Joaquin River Basin of the California Central Valley." Within the action area for the 2008 Amendment component of the OCAP, Central California Coast steelhead are restricted to the Suisun Bay/Suisun Marsh area and its tributaries. Steelhead occurring upstream from Chipps Island (*i.e.*, in portions of the Delta, Yolo Bypass, and Sacramento Valley where other 2008 Amendment actions will take place) are California Central Valley steelhead. Thus, the effects analysis for Central California Coast steelhead focuses on 2008 Amendment conservation actions (*i.e.*, tidal marsh restoration) in the Suisun Marsh.

The 2008 Amendment conservation actions in the Suisun Marsh may result in short-term adverse effects to upstream-migrating adults and outmigrating juveniles and kelts. However, because these projects will restore and enhance habitat conditions for these migrants in the long-term, these projects will not jeopardize the continued existence of the species and will not adversely modify designated critical habitat. On the contrary, these conservation actions will have a net benefit to the species, helping to contribute to its recovery.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for aquatic species and habitat quality, and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating).

Potential effects of the 2008 Amendment actions on the Central California Coast steelhead and designated critical habitat are described below.

Habitat Modification

NMFS (2008c) has identified Central California Coast steelhead priority recovery actions that include research and monitoring of distribution, status, and trends; hatchery operations and development of a hatchery and genetics management plan; improvement of freshwater habitat quantity and quality; protection and restoration of habitat complexity and connectivity from the upper watershed to the ocean; freshwater habitat restoration in anadromous salmonid streams; balancing of water supply and allocation with fisheries needs; improved agricultural and forestry practices, county/city planning, regulations, and road construction and maintenance programs; removal of fish passage barriers; screening of water diversions; improved wastewater management; identification and treatment of point and non-point source pollution; improvement

of channel and flood control maintenance; and elimination of artificial breaching of sandbars for improvements in channel and estuarine habitats.

Of the 2008 Amendment conservation actions, tidal habitat restoration in the Suisun Marsh (*e.g.*, at Hill Slough West and Meins Landing) is the only action that will affect Central California Coast steelhead. Little is known concerning the distribution and habitat use of steelhead in the Suisun Marsh, but these restoration actions are expected to improve estuarine foraging habitat for migrating individuals, and may improve connectivity between high-quality estuarine foraging areas, upstream spawning habitat, and Suisun Bay. Habitat quality is expected to improve by increasing tidally inundated shallow water habitat and marsh ecotones, thus improving the food base and habitat conditions for juvenile rearing and outmigration. Potential short-term adverse effects may occur associated with grading, excavation, placement of fill for levees or berms, and movement of heavy equipment and vehicles, which could result in increased turbidity and suspended sediment, as well as potentially resulting in toxic spills. However, BMPs will be implemented to minimize or avoid any such adverse effects. Potential short-term effects such as increased turbidity and suspended sediment may also occur following breaching of levees during early stages of flooding, until aquatic food webs can establish and initial erosion has occurred; however, BMPs to limit breaching to times of year when target fish species are not present should minimize or avoid any such adverse effects. In addition, there is some evidence that increased turbidity can moderate effects of predation on juvenile salmonids (Nobriga *et al.* 2005).

The 2008 Amendment conservation actions in estuarine habitat used by juvenile Central California Coast steelhead, including the restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh, could potentially result in poor water quality conditions for juveniles, such as low dissolved oxygen, contaminants, mercury accumulation in the food web, and could provide habitat for non-native aquatic plants and predatory fish species. However, Aquatic and Wetland Species/Water Quality BMPs will be implemented to minimize or avoid any such adverse effects. Given that these restoration projects will result in full tidal circulation, it is unlikely that dissolved oxygen levels will adversely affect juvenile Central California Coast steelhead. Invasive aquatic plant species (*e.g.*, Brazilian waterweed and water hyacinth) have been documented to provide habitat for non-native fish species over native fish species (Brown 2003). Efforts to restore tidal wetland and subtidal habitats will need to consider approaches to minimize the risk of invasion of non-native aquatic plant species (Brown 2003). In addition, water quality, non-native aquatic plants, and non-native predatory fish species will be monitored and addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Non-native fish are commonly distributed in the Suisun Marsh (Matern *et al*. 2002). Many of the non-native species, such as largemouth bass and striped bass, are known predators on smaller fish such as juvenile Central California Coast steelhead. The 2008 Amendment conservation actions identified in the Suisun Marsh are likely to provide habitat for these predatory non-native fish species; however, juvenile Central California Coast steelhead are most likely to occur in the restoration sites in the winter and spring when water temperature is at its coldest, which will decrease the potential for overlap between non-native predators and native fish. One of the goals of the conservation actions will be to limit the type of habitat used by non-native fish predators, thereby potentially reducing predation. Non-native predatory fish species will be monitored and

addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Effects on Central California Coast Steelhead Critical Habitat

According to the critical habitat designation for the Central California Coast steelhead, watershed codes 220710 (Suisun Bay) and 220722 (Suisun Creek watershed) were excluded from the critical habitat designation because the benefits of exclusion were thought to outweigh the benefits of inclusion (NMFS 2005). Therefore, no designated critical habitat for the Central California Coast steelhead is present within the 2008 Amendment action area, and tidal marsh restoration activities within the Suisun Marsh will not adversely affect designated critical habitat.

The PCEs for Central California Coast steelhead critical habitat included estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. Although the 2008 Amendment actions will not adversely affect critical habitat for Central California Coast steelhead, these actions will benefit the species by expanding and improving the quality of estuarine habitat for the species. Thus, the 2008 Amendment actions will contribute to the recovery of Central California Coast steelhead.

Effects on Green Sturgeon

The effects of diversions and entrainment of green sturgeon by operational aspects of the OCAP are discussed in sections of this biological assessment pertaining to pump operations. The following section focuses on the effects (overwhelmingly beneficial) of the 2008 Amendment conservation actions on green sturgeon.

Current data and observations document green sturgeon in the Sacramento River as far upstream as Keswick Dam and as far south as the CVP/SWP water export facilities near the southern limit of the Sacramento-San Joaquin Delta. Spawning occurs in the upper Sacramento River. Green sturgeon juveniles, subadults, and adults are widely distributed in the Delta and estuary. The Delta serves as a migration corridor, feeding area, and juvenile rearing habitat for the green sturgeon southern DPS. Juvenile green sturgeon are captured in the Delta during all months of the year. The 2008 Amendment conservation actions in the Yolo Bypass, the Delta, and Suisun Marsh may result in short-term adverse effects to juvenile green sturgeon. However, because these projects will restore and enhance habitat conditions for juvenile green sturgeon in the long-term, these projects will not jeopardize the continued existence of the species. On the contrary, these conservation actions will have a net benefit to the species, helping to contribute to its recovery.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for aquatic species and habitat

quality, and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating).

Critical habitat has not been designated for the green sturgeon. Potential effects of the 2008 Amendment actions on green sturgeon are described below.

Habitat Modification

The 2008 Amendment conservation actions in Battle Creek, Mill Creek, Butte Creek, and the Feather River may result in short-term adverse effects to green sturgeon. Such effects may include short-term mortality, reduced reproductive success, and reduced growth rates as a result of physical disturbance, noise, sedimentation, and accidental spills of chemicals or materials during project activities, as well as the release of sediments stored behind dams that are to be removed in the Battle Creek watershed. However, these projects will restore and enhance habitat conditions, and thus they will provide considerable long-term benefits to green sturgeon that far outweigh any short-term adverse effects.

The 2008 Amendment conservation actions in the Yolo Bypass, western Delta, and Suisun Marsh will improve survival and growth of juvenile green sturgeon by increasing and improving floodplain habitat that should provide/export nutrients and primary production inputs to the Delta and providing estuarine rearing and feeding habitat. The 2008 Amendment conservation actions in estuarine habitat used by juvenile green sturgeon, including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex, and restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh, will consist of tidal restoration projects that are expected to be beneficial. Habitat quality is expected to increase by increasing tidally inundated shallow water habitat and marsh ecotones, improving the food base and habitat conditions for juvenile rearing. Potential short-term adverse effects may occur associated with grading, excavation, placement of fill for levees or berms, and movement of heavy equipment and vehicles, which could result in increased turbidity and suspended sediment, as well as potentially resulting in toxic spills. However, BMPs will be implemented to minimize or avoid any such adverse effects. Potential short-term effects such as increased turbidity and suspended sediment may also occur following breaching of levees during early stages of flooding, until aquatic food webs can establish and initial erosion has occurred; however, BMPs to limit breaching to times of year when target fish species are not present should minimize or avoid any such adverse effects.

The 2008 Amendment conservation actions in estuarine habitat used by juvenile green sturgeon, including the potential restoration of aquatic habitat in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex, and restoration of tidal marsh at Hill Slough West and Meins Landing in the Suisun Marsh, potentially could result in poor water quality conditions for juvenile green sturgeon, such as low dissolved oxygen and contaminants, and could provide habitat for non-native aquatic plants and predatory fish species. However, Aquatic and Wetland Species/Water Quality BMPs will be implemented to minimize or avoid any such adverse effects. Given that the projects are expected to result in full tidal circulation, it is unlikely that dissolved oxygen levels will adversely affect juvenile green sturgeon. The effects of such tidal restoration on mercury

methylation are difficult to predict, but some accumulation of mercury in the food web could occur (Brown 2003). Invasive aquatic plant species (*e.g.*, Brazilian waterweed and water hyacinth) have been documented to provide habitat for non-native fish species over native fish species (Brown 2003). Efforts to restore tidal wetland and subtidal habitats will need to consider approaches to minimize the risk of invasion of non-native aquatic plant species (Brown 2003). In addition, water quality, non-native aquatic plants, and non-native predatory fish species will be monitored and addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Non-native fish are commonly distributed in the Yolo Bypass, the Delta, and Suisun Marsh (Nobriga *et al.* 2005, Feyrer and Healey 2003, Feyer *et al.* 2006, Matern *et al.* 2002, Simenstad *et al.* 2000), although the highest proportions of native fish species occur in the northern Delta (Brown and Michniuk 2007). Many of the non-native species, such as largemouth bass and striped bass, are known predators on smaller fish. The 2008 Amendment conservation actions identified in the Yolo Bypass, the Delta, and Suisun Marsh are likely to provide habitat for these predatory non-native fish species; however, the effects of predators on juvenile green sturgeon are not known. One of the goals of the conservation actions will be to limit the type of habitat used by non-native fish predators, thereby potentially reducing predation. Non-native predatory fish species will be monitored and addressed in the Adaptive Management Plan to ensure that these projects have the desired beneficial effects, and therefore are not anticipated to have an adverse effect.

Non-native invertebrates, such as the overbite clam (*Corbula amurensis*), may invade newly restored tidal and subtidal habitat in the Delta. White sturgeon are known to ingest the overbite clam although 91% of clams observed in the digestive tract were still alive. It is likely that green sturgeon could also prey upon the overbite clam. The effects of having a diet composed primarily of an invasive non-native species are not known, but there are concerns about the quality of nutrition these prey provide, as well as the potential for contaminant exposure.

Effects on California Tiger Salamander

The California tiger salamander breeds in stock ponds, vernal pools, and other temporary pools, but individuals spend most of their lives in small mammal burrows in upland grassland, oak savannah, and other relatively open habitats (USFWS 2005b). Although vernal pool habitat is scattered throughout a number of areas in the Central Valley, the only location where California tiger salamanders are known to be present within the 2008 Amendment action area is in the Potrero Hills along the northeastern edge of the Suisun Marsh area (CNDDB 2008, LSA Associates 2007). This hilly region is surrounded on the west, south, and east by portions of Suisun Marsh. These hills are excluded from the 2008 Amendment action area since they are unsuitable for tidal restoration or other activities to benefit the target fish species.

California tiger salamanders do not typically occur in saline habitats, and the species is thus not expected to breed in brackish or saline diked marshes such as those subject to tidal restoration as part of the 2008 Amendment conservation actions. The CDFG (2005) considered it absent from the Hill Slough West Tidal Restoration project area, and although the Hill Slough West project

area may be within dispersal distance of potential breeding habitat in grasslands to the southeast, tidal marsh and brackish sloughs separating the two areas would preclude dispersal of tiger salamanders to Hill Slough West. The Meins Landing Tidal Restoration project area is not within dispersal distance of the tiger salamander population along the northeastern edge of the Suisun Marsh area, and the species is thus absent from Meins Landing as well. However, California tiger salamanders have been recorded dispersing a mile or more from breeding ponds (Austin and Shaffer 1992), possibly up to 1.3 miles (Orloff 2007), and there is some potential for tiger salamanders breeding in temporary, freshwater pools within the grasslands in the Potrero Hills to disperse into areas that could be subject to future tidal restoration.

California tiger salamanders have also been recorded breeding immediately outside the action area in the Jepson Prairie area. Although 2008 Amendment actions will not directly affect the Jepson Prairie, there is some potential for tiger salamanders breeding in the Jepson Prairie to disperse into the margins of areas that could be subject to restoration in the westernmost portion of the Cache Slough Complex.

Given the extent of the California tiger salamander's range, the low probability that California tiger salamanders are breeding within the action area, and the low number of individuals that could be impacted by the 2008 Amendment actions, potential conservation actions in the Suisun Marsh and western Cache Slough Complex would result in adverse effects to only a fraction of the populations of this species, at most. These projects will not jeopardize the continued existence of the species.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for this species and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating) or will be compensated (*e.g.*, through California tiger salamander habitat preservation or creation).

Potential effects of the 2008 Amendment actions on the California tiger salamander and its designated critical habitat are described below.

Habitat Modification

As noted above, the Hill Slough West and Meins Landing tidal restoration projects are not expected to affect the California tiger salamander or its habitat, and other restoration projects in Suisun Marsh would not convert upland habitat in the Potrero Hills to tidal marsh. However, if future tidal restoration occurs in areas that are contiguous with the grasslands occupied by tiger salamanders in the Potrero Hills, there is some potential for these projects to impact tiger salamander habitat. Most likely, tiger salamanders would occur only in the upland margins of the diked marshes that would be subject to tidal restoration. However, in such areas, localized loss of habitat could result from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and other project-related activities. At any one location, the extent of habitat to be impacted by these activities will be limited. More extensive habitat loss could occur due to flooding following breaching of levees, if upland habitats conducive to current tiger salamander use were flooded. However, tiger salamanders likely make little use of the diked marshes that would be inundated.

BMPs will be implemented to avoid and minimize adverse effects to occupied California tiger salamander habitat in all 2008 Amendment project areas where the species could occur (see *Best Management Practices* above).

Loss of Individuals

If future tidal restoration occurs in the northeastern portion of Suisun Marsh in areas occupied by tiger salamanders, these actions could result in the injury or mortality of individual salamanders as a result of grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, trampling by vehicles accessing construction or monitoring areas, and other project-related activities. BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on California Tiger Salamander Critical Habitat

Critical habitat for the California tiger salamander has been designated, and critical habitat unit 2 of the Central Valley Region is present in the Jepson Prairie area, west of the action area. No 2008 Amendment conservation actions will occur within this critical habitat unit. Therefore, these actions will not result in the adverse modification of designated critical habitat for this species.

Effects on California Red-legged Frog

The California red-legged frog is typically associated with streams, pools, and ponds having dense emergent wetland or woody riparian vegetation. Although the species formerly ranged throughout much of the Central Valley from Redding (Shasta County) south, and along the coast from Marin County southward, it has disappeared from approximately 70% of its former range, including most of the Central Valley floor (USFWS 2002). Within the 2008 Amendment action area, the only location where this species may still occur is in the Suisun Marsh area. The area immediately west of the Suisun Marsh, separated from the Marsh by Interstate 680, is considered a "core area" for the species in the 2002 recovery plan (USFWS 2002), and has been designated as critical habitat for the species (USFWS 2006b).

Throughout most of their range, California red-legged frogs are associated with freshwater habitats. However, this species does occur in brackish coastal lagoons (USFWS 2006b), and the less saline portions of Suisun Marsh could support this species. The USFWS (2002) recovery plan for the species notes that there are three records near Suisun Marsh, but there are no CNDDB records of the species from areas of Suisun Marsh suitable for tidal restoration pursuant to the 2008 Amendment. California red-legged frogs were considered absent from the Hill Slough West Tidal Restoration project area by the CDFG (2005). Because the Meins Landing Tidal Restoration project area is even closer to Suisun Bay (and thus farther from potential source populations in hills west of Suisun Marsh), red-legged frogs are not expected to occur at Meins Landing. The northern and eastern portions of the Suisun Marsh are highly unlikely to support red-legged frogs, since they are far from potential source populations in the hills west of the Marsh, and since they are separated from those source populations by extensive areas of diked marsh that provide poor habitat for the species. The only potential tidal restoration areas

in Suisun Marsh where there is a reasonable potential for occurrence by red-legged frogs is along the western edge of the Marsh.

Given the extent of the California red-legged frog's range and the low number of individuals that could be impacted by the 2008 Amendment actions, potential conservation actions in the Suisun Marsh would result in adverse effects to only a fraction of the populations of this species, at most. These projects will not jeopardize the continued existence of the species.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for this species and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating) or will be compensated (*e.g.*, through California red-legged frog habitat preservation or creation).

Potential effects of the 2008 Amendment actions on the California red-legged frog and its designated critical habitat are described below.

Habitat Modification

As noted above, the Hill Slough West and Meins Landing tidal restoration projects are not expected to affect the California red-legged frog or its habitat. However, if future tidal restoration occurs in the western portion of Suisun Marsh, and if red-legged frogs are present there, these projects could result in the loss of red-legged frog habitat. Localized loss of habitat could result from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and other project-related activities. At any one location, the extent of habitat to be impacted by these activities will be limited. More extensive habitat loss could occur due to flooding following breaching of levees, which could inundate nontidal marsh habitat and convert it to tidal marsh, which would be even less suitable for red-legged frogs than the existing diked marshes.

BMPs will be implemented to avoid and minimize adverse effects to occupied California red-legged frog habitat in all 2008 Amendment project areas where the species could occur (see *Best Management Practices* above) to minimize impacts to this species' habitat.

Loss of Individuals

If future tidal restoration occurs in the western portion of Suisun Marsh, and if red-legged frogs are present there, these actions could result in the injury or mortality of individual frogs as a result of grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, trampling by vehicles accessing construction or monitoring areas, and other project-related activities. BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on California Red-legged Frog Critical Habitat

Critical habitat for the California red-legged frog has been designated (USFWS 2006b), and critical habitat unit SOL-1 is present in the hills immediately west of the Suisun Marsh. However, this critical habitat unit is separated from Suisun Marsh by Interstate 680, and no 2008 Amendment conservation actions will occur within the critical habitat unit. Therefore, these actions will not result in the adverse modification of designated critical habitat for this species.

Effects on Giant Garter Snake

The giant garter snake occurs in freshwater wetlands and moist agricultural areas, especially rice fields, in the Sacramento Valley, and less commonly in the San Joaquin Valley (USFWS 1999). This species has declined in or disappeared from many areas within its former range, and it is now apparently rare and sparsely distributed in much of its current range. The Battle Creek Salmon and Steelhead Restoration project is north of the species' range, and potential 2008 Amendment conservation actions in the Suisun Marsh are also outside the species' range. The 2008 Amendment actions at Deer Creek, Mill Creek, and Butte Creek are very near the limit of the species' range, as delimited by CNDDB records. However, due to the lack of project-specific information about the status of the giant garter snake in those areas, a conservative approach is taken here, and the species is presumed to be potentially present in those areas.

The giant garter snake is known to occur along the western edge of the Yolo Bypass. Occurrence in the Cache Slough area of Solano County is uncertain; although there is a CNDDB record within 2 miles northwest of the western Cache Slough Complex and approximately 1 mile west of the Yolo Bypass (CNDDB 2008), a focused trapping survey at 17 locations in eastern Solano County in 2004 and 2005 failed to detect the species (Wylie and Martin 2005). Nevertheless, based on CNDDB (2008) records and those summarized in USFWS (1999), as well as the extent of the species former range and the species' recovery units, the potential 2008 Amendment conservation actions that may occur within the range of the species are presumed to include:

- Aquatic habitat restoration projects in the western Cache Slough Complex and at Prospect Island, Liberty Island, Little Holland Tract, and Eastern Egbert Tract elsewhere in the Cache Slough Complex
- Activities to enhance fish habitat and passage in the Yolo Bypass, including the Lower Putah Creek realignment, Lisbon Weir improvements, additional multi-species floodplain habitat development improvements, Tule Canal conductivity improvements, and Fremont Weir fish passage improvements
- The Deer Creek Flow Enhancement Program
- The Mill Creek Water Exchange Program and Mill Creek Water Right Opportunities project
- The Parrott Phelan and Durham Mutual Dam fish ladder and screen maintenance project

The tidal marsh restoration projects and other habitat enhancements that may occur pursuant to the 2008 Amendment in the Cache Slough Complex, the Delta, and the Yolo Bypass could potentially enhance habitat for the giant garter snake. The extent to which this species uses tidal freshwater marsh habitat is unclear, as there appear to be few recent records from tidal habitats. However, the 2008 Amendment restoration projects will create very large marshes providing a diverse mosaic of microhabitats, and it is likely that conversion of farmland and other upland habitats to extensive marshland would be beneficial to this species. Other 2008 Amendment projects, such as along Deer Creek, Mill Creek, and Butte Creek, involve very limited activities that could adversely affect giant garter snakes. Thus, 2008 Amendment activities will not jeopardize the continued existence of the giant garter snake, and rather, the net effect of these activities is expected to be beneficial, contributing to the species' recovery.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for this species, and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating), or will be compensated (*e.g.*, through giant garter snake habitat preservation or restoration).

Critical habitat has not been designated for the giant garter snake. Potential effects of the 2008 Amendment actions on the giant garter snake are described below.

Habitat Modification

The action area for the tidal restoration projects and other habitat improvement projects in the Cache Slough Complex, Delta, and Yolo Bypass will include some areas that currently have extensive wetlands and that could currently provide habitat for the giant garter snake. Within these areas, modification of habitat for this species could occur in several ways. Localized loss of habitat for the giant garter snake could result from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and other project-related activities. At any one location, the extent of habitat to be impacted by these activities will be limited. More extensive habitat loss could occur due to flooding following breaching of levees, which could inundate nontidal marsh habitat and convert it to tidal marsh. However, based on recent records and the negative results of focused surveys such as those of Wylie and Martin (2005) in eastern Solano County, it is unlikely that extensive wetlands occupied by giant garter snakes will be impacted by tidal restoration activities.

If this species uses tidal marshes downstream from a tidal restoration project area, some habitat could be lost due to the scour of existing marsh, which may result from an increase in tidal prism after tidal action is restored to diked marshes. This short-term loss of habitat from fringe marsh scour would be more than offset by the development of additional tidal marsh habitat in restored marshes.

Restoration and conservation actions in the Delta and the Yolo Bypass could potentially enhance habitat for the giant garter snake, particularly where farmland or other upland habitat will be converted to extensive marshland providing a diverse mosaic of wetland habitats. Such effects would be beneficial to the species.

Activities associated with the Deer Creek Water Exchange Program, Mill Creek Water Exchange Program, Mill Creek Water Right Opportunities project, and Parrott Phelan and Durham Mutual Dam fish ladder and screen maintenance project have a low probability of adversely affecting giant garter snake habitat, both because the species may not occur in those areas (which are near the edge of the species' range) and because few activities associated with these projects have the potential to adversely affect wetland habitats. The Deer Creek and Mill Creek projects could benefit the species, if it is present along those creeks, by reducing agricultural diversions from those streams. There is some potential for activities associated with drilling of wells and construction of well access roads for the Deer Creek and Mill Creek projects, and the movement of heavy equipment, vehicles, and project personnel for all three projects, to impact wetlands suitable for giant garter snakes. However, BMPs will be implemented to avoid and minimize adverse effects to occupied giant garter snake habitat in all 2008 Amendment project areas where the species could occur (see *Best Management Practices* above).

Loss of Individuals

During implementation of 2008 Amendment conservation actions in giant garter snake habitat, individual snakes could be destroyed as a result of grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, trampling by vehicles accessing construction or monitoring areas, and other project-related activities. There is a low potential for impacts to individual snakes during activities associated with drilling of wells and construction of well access roads for the Deer Creek and Mill Creek projects, and the movement of heavy equipment, vehicles, and project personnel for these and the Butte Creek projects. BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on California Clapper Rail

The California clapper rail occurs in fully tidal salt marsh, and occasionally brackish marsh, throughout the San Francisco Bay area. In the 2008 Amendment action area, it occurs only in salt and brackish marsh habitat within Suisun Marsh. This species breeds, and typically forages, only in fully tidal marshes. Potential 2008 Amendment conservation actions in the Suisun Marsh, such as the Hill Slough West and Meins Landing tidal marsh restoration projects, will target the restoration of tidal action to diked areas, and thus effects on this species will be minimal. These projects will not jeopardize the continued existence of the species. Furthermore, 2008 Amendment actions involving tidal marsh restoration in the Suisun Marsh would enhance habitat for this species considerably by restoring extensive marshes with complex channel networks that provide high-quality breeding and foraging habitat. Thus, these actions will have a net benefit to the California clapper rail and contribute to the species' recovery.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for this species, and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating).

Critical habitat has not been designated for the California clapper rail. Potential effects of the 2008 Amendment actions on the California clapper rail are described below.

Habitat Modification

The only projects implemented in the vicinity of populations of this species pursuant to the 2008 Amendment would be Suisun Marsh tidal marsh restoration projects. Habitat for the California clapper rail is absent from the Hill Slough West Tidal Marsh Restoration project area (CDFG 2005) and is likely absent from the diked marshes that comprise the Meins Landing Tidal Marsh Restoration project area. Clapper rails are unlikely to occur in other diked marshes that will serve as the sites for restoration actions in the Suisun Marsh. However, California clapper rail habitat may be present on the outboard side of levees that will be breached to restore tidal action to these diked marshes. Small-scale, localized loss of habitat could result from excavation during breaching of levees in such areas, side-casting of excavated or dredged material into marshes, and movement of heavy equipment, vehicles, and project personnel during restoration and monitoring. At any one location, the extent of habitat to be impacted will be very small compared to the proposed restoration, however.

Some habitat for this species could also be lost due to the scour of existing marsh along tidal sloughs, which may result from an increase in tidal prism after tidal action is restored to diked marshes. This short-term loss of California clapper rail habitat from fringe marsh scour will be more than offset by the development of additional tidal marsh habitat in restored marshes.

Because 2008 Amendment conservation actions in and near habitat for this species will consist of tidal restoration projects, the net effect of such projects on California clapper rail habitat will be beneficial. Overall habitat extent and quality will increase, creating larger marshes with complex channel networks and upper marsh ecotone habitat that would provide high-tide refugia. Furthermore, BMPs will be implemented to avoid and minimize adverse direct and indirect effects to occupied areas (see *Best Management Practices* above).

Loss or Disturbance of Individuals

There is a low probability that adult California clapper rails would be killed or injured by 2008 Amendment activities. Breaching of levees separating diked marshes from tidal channels is the only activity that would directly impact clapper rail habitat (on the outboard side of such levees), and adults would likely flee the impact area before they could be harmed. However, if rails were breeding in the outboard marsh at the breach location, breaching of levees in such areas, side-casting of excavated or dredged material into marshes, and movement of heavy equipment, vehicles, and project personnel during restoration and monitoring could result in nest destruction or trampling of chicks. The noise, vibrations, and movement of personnel and equipment associated with such activities could disturb clapper rails if restoration activities occurred close to rail habitat, possibly leading to abandonment of nests, eggs, and young, loss of foraging opportunities near suitable habitat, and increased predation or competition as rails are displaced into other areas. BMPs such as seasonal restrictions on restoration activities near occupied clapper rail habitat will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above). The restoration of extensive tidal marsh in areas with existing diked marsh will result in population benefits that more than offset any minor disturbance or loss of individuals that could occur as a result of restoration activities.

Effects on Western Snowy Plover

The western snowy plover breeds on beaches and salt pannes along the Pacific Coast. In San Francisco Bay, it breeds primarily in salt ponds, where it nests in salt pannes and on small islands within the managed ponds. Within San Francisco Bay, most plovers breed in the South Bay. Elsewhere, a few pairs in Napa salt ponds represented the only breeders in the North Bay area until breeding snowy plovers were discovered in 2006 at the Montezuma Wetlands project area on the east side of Montezuma Slough near Birds Landing (Napa-Solano Audubon Society 2006). This location, which is in the Suisun Marsh, is the only location in the 2008 Amendment action area where western snowy plovers are known to breed. The Hill Slough West Tidal Restoration project area is located several miles to the northwest of the Montezuma Wetlands project breeding area, and does not provide suitable nesting habitat for snowy plovers. Although the Meins Landing Tidal Restoration project area is located immediately to the northwest of the Montezuma Wetlands, it also lacks nesting habitat for this species due to the vegetated nature of the site. Because snowy plovers are opportunistic breeders, locating and using suitable habitat as it becomes available rather than necessarily remaining in one breeding location year after year, it is possible that future restoration elsewhere in the Suisun Marsh pursuant to the 2008 Amendment may occur near occupied snowy plover breeding areas.

The 15-20 snowy plovers observed at Montezuma Slough in 2006 represent a very small proportion of the species' population, and thus no 2008 Amendment activities could jeopardize the continued existence of the species. During the project-specific section 7 consultations that will occur for individual projects such as Meins Landing, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for this species.

Potential effects of the 2008 Amendment actions on the western snowy plover and designated critical habitat are described below.

Habitat Modification

The only projects implemented in the vicinity of populations of this species pursuant to the 2008 Amendment would be Suisun Marsh tidal marsh restoration projects. Habitat for the western snowy plover is absent from the Hill Slough West Tidal Marsh Restoration project area and vicinity (CDFG 2005), and is absent from the diked wetlands that comprise the Meins Landing Tidal Restoration project area as well, based on habitat descriptions by the California Coastal Conservancy (2004). At the Montezuma Wetlands project, breeding snowy plovers were observed using extensive bare areas created by the disposal of dredged materials that were being used to raise the elevation of the marsh prior to tidal restoration (Napa-Solano Audubon Society 2006). Such barren habitat is absent from the diked marshes that 2008 Amendment restoration actions in the Suisun Marsh will target. However, if similar methods (*i.e.*, use of dredged materials) are used to raise the elevation of Meins Landing or other tidal restoration sites in the Suisun Marsh, this could temporarily create breeding habitat for snowy plovers. If this were to occur, implementation of the previously described BMPs would minimize adverse direct and indirect effects to occupied areas (see *Best Management Practices* above).

Loss or Disturbance of Individuals

Anticipated restoration actions pursuant to the 2008 Amendment in the Suisun Marsh will restore tidal action to diked marshes. These diked marshes, such as those at the Hill Slough West and Meins Landing tidal restoration project areas, do not provide breeding habitat for western snowy plovers due to their vegetated condition. However, if dredged materials are used to raise the elevation of Meins Landing or other tidal restoration sites in the Suisun Marsh, snowy plovers could attempt to breed within the project area.

If future restoration were to occur in or near occupied snowy plover breeding habitat, adult snowy plovers would not be killed or injured by restoration activities, as they would flee the impact area before they could be harmed. However, if plovers were nesting in an area to be restored, then in the absence of BMPs, nests, eggs, or chicks could be destroyed by grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, and trampling by vehicles accessing construction or monitoring areas. Chicks or eggs could be drowned if flooding occurred (as a result of breaching of levees) in occupied habitat during the nesting season. The noise, vibrations, and movement of personnel and equipment associated with restoration activities could disturb nesting snowy plovers if restoration activities occurred close to snowy plover habitat, possibly leading to abandonment of nests, eggs, and young, loss of foraging opportunities near suitable habitat, and increased predation or competition as plovers are displaced into other areas. BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above), minimizing the likelihood of such impacts.

Effects on Western Snowy Plover Critical Habitat

Critical habitat for the western snowy plover has been designated (USFWS 2005c). However, designated critical habitat for the species is absent from the 2008 Amendment action area, and these actions will not result in the adverse modification of designated critical habitat for this species.

Effects on California Least Tern

The California least tern breeds on sandy beaches, salt pannes, and other similar open habitats along the Pacific Coast. In San Francisco Bay, the main colony is located on an old airport runway at the Alameda National Wildlife Refuge near Oakland. Smaller colonies have occurred around the Bay in Fremont, Hayward, and near Pittsburg, but the species was not known to nest in the 2008 Amendment action area until 2006, when a colony of 17-24 pairs was discovered at the Montezuma Wetlands project area on the east side of Montezuma Slough near Birds Landing (Napa-Solano Audubon Society 2006, Shuford undated). This location, which is in the Suisun Marsh, is the only location in the 2008 Amendment action area where California least terns are known to breed. The Hill Slough West Tidal Restoration project area is located several miles to the northwest of the Montezuma Wetlands project breeding area and does not provide suitable nesting habitat for snowy plovers. Although the Meins Landing Tidal Restoration project area is located immediately to the northwest of the Montezuma Wetlands, it also lacks nesting habitat for this species due to the vegetated nature of the site. Because these terns appeared shortly after

the disposal of dredged materials created suitable breeding habitat, it is also possible that future restoration elsewhere in the Suisun Marsh pursuant to the 2008 Amendment may occur near occupied least tern breeding areas if habitat for the species is created elsewhere in the marsh.

The 17-24 pairs of least terns observed at Montezuma Slough in 2006 represent a very small proportion of the species' population, and thus the 2008 Amendment conservation actions will not jeopardize the continued existence of the species. During the project-specific section 7 consultations that will occur for individual projects such as Meins Landing, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for this species. Furthermore, tidal restoration projects could potentially increase prey resources for the piscivorous least tern, and thus tidal restoration could benefit the species by improving prey abundance and foraging opportunities.

Critical habitat has not been designated for the California least tern. Potential effects of the 2008 Amendment actions on this species are described below.

Habitat Modification

The only projects implemented in the vicinity of populations of this species pursuant to the 2008 Amendment would be Suisun Marsh tidal marsh restoration projects. Habitat for the California least tern is absent from the Hill Slough West Tidal Marsh Restoration project area and vicinity (CDFG 2005) and is likely absent from the diked wetlands that comprise the Meins Landing Tidal Restoration project area as well, based on habitat descriptions by the California Coastal Conservancy (2004). At the Montezuma Wetlands project, breeding least terns were observed using extensive bare areas created by the disposal of dredged materials that were being used to raise the elevation of the marsh prior to tidal restoration (Napa-Solano Audubon Society 2006). Such barren habitat is absent from the diked marshes that 2008 Amendment restoration actions in the Suisun Marsh will target. However, if similar methods (*i.e.*, use of dredged materials) are used to raise the elevation of Meins Landing or other tidal restoration sites in the Suisun Marsh, this could temporarily create breeding habitat for least terns. If this were to occur, implementation of the previously described BMPs would minimize adverse direct and indirect effects to occupied areas (see *Best Management Practices* above).

Loss or Disturbance of Individuals

Anticipated restoration actions pursuant to the 2008 Amendment in the Suisun Marsh will restore tidal action to diked marshes. These diked marshes, such as those at the Hill Slough West and Meins Landing tidal restoration project areas, do not provide breeding habitat for California least terns due to their vegetated condition. However, if dredged materials are used to raise the elevation of Meins Landing or other tidal restoration sites in the Suisun Marsh, least terns could attempt to breed within the project area.

If future restoration were to occur in or near occupied California least tern breeding habitat, adult terns would not be killed or injured by restoration activities, as they would flee the impact area before they could be harmed. However, if least terns were nesting in an area to be restored, then in the absence of BMPs, nests, eggs, or chicks could be destroyed by grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel, and

trampling by vehicles accessing construction or monitoring areas. Chicks or eggs could be drowned if flooding occurred (as a result of breaching of levees) in occupied habitat during the nesting season. The noise, vibrations, and movement of personnel and equipment associated with restoration activities could disturb nesting terns if restoration activities occurred close to their breeding habitat, possibly leading to abandonment of nests, eggs, and young, loss of foraging opportunities near suitable habitat, and increased predation or competition as terns are displaced into other areas. BMPs will be implemented to avoid and minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Effects on Salt Marsh Harvest Mouse

The salt marsh harvest mouse occurs in diked and tidal salt marsh, and occasionally brackish marsh, throughout the San Francisco Bay area. In the 2008 Amendment action area, it occurs only in salt and brackish marsh habitat within Suisun Marsh. The diked marshes that would be restored to tidal habitats by 2008 Amendment conservation actions in the Suisun Marsh currently provide salt marsh harvest mouse habitat. The species is known to occur at the Hill Slough West Tidal Marsh Restoration project area (CDFG 2005), and pickleweed habitat is present at the Meins Landing Tidal Restoration project area (California Coastal Conservancy 2004), likely supporting salt marsh harvest mice. However, 2008 Amendment conservation actions in the Suisun Marsh could affect only a very small fraction of the total population or occupied habitat of this species, and such projects will not jeopardize the continued existence of the species. Furthermore, 2008 Amendment actions involving tidal marsh restoration in the Suisun Marsh would enhance habitat for this species, thus having a net benefit to the salt marsh harvest mouse and helping to contribute to the species' recovery.

During the project-specific section 7 consultations that will occur for individual projects, the effects of individual projects on this species will be analyzed in greater detail. It is expected that these projects will implement the BMPs previously described for this species, and that any residual incidental take will be authorized as incidental to a project that is otherwise beneficial to the species (*i.e.*, self-mitigating).

Potential effects of the 2008 Amendment actions on the salt marsh harvest mouse are described below.

Habitat Modification

Projects implemented in the vicinity of populations of this species pursuant to the 2008 Amendment will be Suisun Marsh tidal marsh restoration projects. Because habitat for the salt marsh harvest mouse is present at the Hill Slough West and Meins Landing tidal marsh restoration project areas, and in other diked marshes in the Suisun Marsh, modification of habitat for this species could occur in several ways. Some habitat for this species could be lost due to the scour of existing marsh, which may result from an increase in tidal prism after tidal action is restored to diked marshes. This short-term loss of salt marsh harvest mouse habitat and connectivity from fringe marsh scour will be more than offset by the development of additional tidal marsh habitat in restored marshes.

Small-scale, localized loss of habitat for the salt marsh harvest mouse could result from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel during restoration and monitoring, side-casting of excavated or dredged material into marshes, flooding following breaching of levees, and other project-related activities. At any one location, the extent of habitat to be impacted would be very small compared to the marsh that would be restored by tidal restoration, however. Where salt marsh harvest mouse habitat is present inside a diked marsh to be restored to tidal action, such as at Hill Slough West and Meins Landing, habitat for this species would be lost due to inundation when breaching occurs. However, more extensive, high-quality tidal salt marsh will be restored in these areas as elevations suitable for pickleweed colonization are achieved through sedimentation of the tidal restoration areas.

Because 2008 Amendment conservation actions in and near habitat for this species will consist of tidal restoration projects, the net effect of such projects on salt marsh harvest mouse habitat will be beneficial following an interim decline in habitat. Overall extent and quality of habitat in these areas will increase as they experience more direct tidal influence, creating larger marshes with upper marsh ecotone habitat that would provide high-tide refugia. Furthermore, BMPs will be implemented to minimize adverse direct and indirect effects to occupied areas (see *Best Management Practices* above).

Loss of Individuals

There are several ways in which 2008 Amendment conservation actions could potentially result in loss of individual salt marsh harvest mice. Individuals could be killed or injured as a result of grading, excavation, placement of fill for levees or berms, trampling by heavy equipment and project personnel during restoration and monitoring, trampling by vehicles accessing construction or monitoring areas, flooding following breaching of levees or other changes in currently suitable hydrologic regimes, and other project-related activities. Such effects, particularly flooding following breaching, could result in a decline in abundance of salt marsh harvest mice within diked marshes providing suitable habitat, such as at the Hill Slough West and Meins Landing tidal marsh restoration project areas. Over time, however, such restoration projects will augment populations by increasing habitat availability and quality. In addition, BMPs will be implemented to minimize adverse effects to individuals of this species (see *Best Management Practices* above).

Delta Fish Agreement 2008 Amendment – Cumulative Effects

As discussed under the programmatic effects analysis for the 2008 Amendment conservation actions above, the most significant effects of these conservation actions on the delta smelt, longfin smelt, Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, and green sturgeon will be substantial habitat and population enhancements resulting from habitat restoration and other activities that are specifically focused on increasing habitat, enhancing habitat conditions, improving access to habitat, and protecting individual fish. These are substantial benefits for these species.

Other listed species, including the soft bird's-beak, Suisun thistle, giant garter snake, California clapper rail, and salt marsh harvest mouse, and possibly also the valley elderberry longhorn beetle, will also benefit from proposed habitat restoration activities under the 2008 Amendment. Other past, present, and future projects throughout the range of these species will result in effects to these species, some beneficial and some adverse. However, because the effects of 2008 Amendment conservation actions on these species will be beneficial, the conservation actions will not contribute to any adverse cumulative effects to these species. Rather, these actions will contribute to the recovery of these species.

The other listed species considered in this analysis, including Hoover's spurge, hairy Orcutt grass, slender Orcutt grass, Greene's tuctoria, Colusa grass, Solano grass, Contra Costa goldfields, Conservancy fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, California tiger salamander, California red-legged frog, western snowy plover, and California least tern, have the potential to be adversely affected by the 2008 Amendment conservation actions. Because habitat restored for the target fish species may not be consistent with habitat for these other species, there is some potential for these actions to result in adverse effects on these species, but these adverse effects will be minimal in light of BMPs to be implemented.

Most other projects that could potentially affect these species will have associated federal actions because they will involve Clean Water Act section 404 permitting, will occur on federal lands, or will involve federal funding. As a result, relatively few projects have the potential to result in cumulative effects that would not be subject to future section 7 consultation. Moreover, within the action area for these conservation actions there are a number of Habitat Conservation Plans (HCPs) being prepared that will increase protection of existing populations of these species and help expand those populations. Solano County, Yolo County, and Sacramento County all have such HCPs in various stages of preparation and approval.

Delta Fish Agreement 2008 Amendment – Determinations

Soft bird's-beak. The 2008 Amendment conservation actions are likely to adversely affect soft bird's-beak due to the potential for loss of habitat and individuals resulting from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, flooding following breaching of levees, scour of existing marshes due to an increase in tidal prism following breaching, and generation of dust during restoration and monitoring activities. Flooding due to breaching at tidal restoration sites will result in temporary loss of habitat, at least until sedimentation has elevated the restored marshplain to suitable elevations for colonization by this species. However, the diked marshes in which these restoration actions will occur do not provide high-quality habitat for the species, and these actions will result in restoration of tidal marsh habitat for the species that more than offsets any temporary, small-scale adverse effects. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of soft bird's-beak. Designated critical habitat for soft bird's-beak is present within the action area, but the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat. Rather, the conservation actions will have a substantial net benefit to the species, thus contributing to its recovery.

Suisun thistle. The 2008 Amendment conservation actions are likely to adversely affect Suisun thistle due to the potential for loss of habitat and individuals resulting from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, flooding following breaching of levees, scour of existing marshes due to an increase in tidal prism following breaching, and generation of dust during restoration and monitoring activities. Flooding due to breaching at tidal restoration sites will result in temporary loss of habitat, at least until sedimentation has elevated the restored marshplain to suitable elevations for colonization by this species. However, the diked marshes in which these restoration actions will occur do not provide high-quality habitat for the species, and these actions will result in restoration of tidal marsh habitat for the species that more than offsets any temporary, small-scale adverse effects. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of Suisun thistle. Designated critical habitat for Suisun thistle is present within the action area, but the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat. Rather, the conservation actions will have a substantial net benefit to the species, thus contributing to its recovery.

Hoover's spurge. The 2008 Amendment conservation actions are likely to adversely affect Hoover's spurge due to the potential for changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of well access roads modify runoff patterns, grading (*e.g.,* for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and generation of dust during restoration

and monitoring activities. However, only limited activities could occur in Hoover's spurge habitat, and these activities would result in minimal ground disturbance. Thus, with implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of Hoover's spurge. Designated critical habitat for Hoover's spurge is present within the action area, but with implementation of BMPs, the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat.

Hairy Orcutt grass. The 2008 Amendment conservation actions are likely to adversely affect hairy Orcutt grass due to the potential for changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of well access roads modify runoff patterns, grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and generation of dust during restoration and monitoring activities. However, only limited activities could occur in hairy Orcutt grass habitat, and these activities would result in minimal ground disturbance. Thus, with implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the project will not jeopardize the continued existence of hairy Orcutt grass. Designated critical habitat for hairy Orcutt grass is present within the action area, but with implementation of BMPs, the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat.

Slender Orcutt grass. The 2008 Amendment conservation actions are likely to adversely affect slender Orcutt grass due to the potential for changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of well access roads modify runoff patterns, grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and generation of dust during restoration and monitoring activities. However, only limited activities could occur in slender Orcutt grass habitat, and these activities would result in minimal ground disturbance. Thus, with implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of slender Orcutt grass. Designated critical habitat for slender Orcutt grass is present within the action area, but with implementation of BMPs, the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat.

Greene's tuctoria. The 2008 Amendment conservation actions are likely to adversely affect Greene's tuctoria due to the potential for changes in the hydrologic regime supporting vernal pool conditions if drilling of wells or construction of well access roads modify runoff patterns, grading (*e.g.*, for access roads, if necessary to reach wells), well-drilling, excavation, movement of heavy equipment, vehicles, and project personnel, and generation of dust during restoration and monitoring activities. However, only limited activities could occur in Greene's tuctoria habitat, and these activities would result in minimal ground disturbance. Thus, with implementation of BMPs to avoid and minimize impacts, any adverse effects on this species

would be minor, and the conservation actions will not jeopardize the continued existence of Greene's tuctoria. Designated critical habitat for Greene's tuctoria is present within the action area, but with implementation of BMPs, the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat.

Colusa grass. The 2008 Amendment conservation actions are likely to adversely affect Colusa grass due to the potential for changes in the hydrologic regime supporting vernal pool conditions, grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and generation of dust during restoration and monitoring activities, if the species is found to be present in the action area. To date, Colusa grass has not been recorded in the action area, and it is possible that it does not occur here. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of Colusa grass. Designated critical habitat for Colusa grass is not present within the action area, and the 2008 Amendment will thus not result in adverse modification of designated critical habitat.

Solano grass. The 2008 Amendment conservation actions are likely to adversely affect Solano grass due to the potential for changes in the hydrologic regime supporting vernal pool conditions, grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and generation of dust during restoration and monitoring activities, if the species is found to be present in the action area. To date, Solano grass has not been recorded in the action area, and it is possible that it does not occur here. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of Solano grass. Designated critical habitat for Solano grass is not present within the action area, and the 2008 Amendment will thus not result in adverse modification of designated critical habitat.

Contra Costa goldfields. The 2008 Amendment conservation actions are likely to adversely affect Contra Costa goldfields due to the potential for loss of habitat and individuals resulting from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, flooding following breaching of levees, and generation of dust during restoration and monitoring activities. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of Contra Costa goldfields. Designated critical habitat for Contra Costa goldfields is present within the action area, but with implementation of BMPs the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat.

Conservancy fairy shrimp. The 2008 Amendment conservation actions are likely to adversely affect the Conservancy fairy shrimp due to the potential for changes in the hydrologic regime supporting vernal pool conditions, grading, well-drilling, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and generation of dust during restoration and monitoring activities. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of the Conservancy fairy shrimp. Designated critical habitat for the Conservancy fairy shrimp is present within the action area, but with implementation of BMPs, the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat.

Vernal pool fairy shrimp. The 2008 Amendment conservation actions are likely to adversely affect the vernal pool fairy shrimp due to the potential for changes in the hydrologic regime supporting vernal pool conditions, grading, well-drilling, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and generation of dust during restoration and monitoring activities. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of the vernal pool fairy shrimp. Designated critical habitat for the vernal pool fairy shrimp is present within the action area, but with implementation of BMPs, the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat.

Vernal pool tadpole shrimp. The 2008 Amendment conservation actions are likely to adversely affect the vernal pool tadpole shrimp due to the potential for changes in the hydrologic regime supporting vernal pool conditions, grading, well-drilling, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and generation of dust during restoration and monitoring activities. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of the vernal pool tadpole shrimp. Designated critical habitat for the vernal pool tadpole shrimp is present within the action area, but with implementation of BMPs, the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat.

Valley elderberry longhorn beetle. The 2008 Amendment conservation actions are likely to adversely affect the valley elderberry longhorn beetle due to the potential for changes in the hydrologic regime supporting its host plant, clearing, grading, well-drilling, excavation, placement of fill for levees or berms, and movement of heavy equipment, vehicles, and project personnel. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of the valley elderberry longhorn beetle. Designated critical habitat for the valley elderberry longhorn beetle is not present within the action area, and thus the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat. Rather,

the conservation actions may confer a net benefit to the species by allowing for the natural restoration of riparian habitat (which would benefit the host plant) at the upland edges of restored wetlands in the Delta, the Cache Slough Complex, and possibly the Yolo Bypass.

California tiger salamander. The 2008 Amendment conservation actions are likely to adversely affect the California tiger salamander due to the potential for impacts to upland habitat and individuals of the species resulting from grading, excavation, placement of fill for levees or berms, and movement of heavy equipment, vehicles, and project personnel. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of the California tiger salamander. Designated critical habitat for the California tiger salamander is not present within the action area, and the 2008 Amendment will thus not result in adverse modification of designated critical habitat.

California red-legged frog. The 2008 Amendment conservation actions are likely to adversely affect the California red-legged frog due to the potential for impacts to habitat and individuals resulting from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and changes in hydrology due to tidal habitat restoration. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of the red-legged frog. Designated critical habitat for the California red-legged frog is not present within the action area, and the 2008 Amendment will thus not result in adverse modification of designated critical habitat.

Giant garter snake. The 2008 Amendment conservation actions are likely to adversely affect the giant garter snake due to the potential for loss of habitat and individuals resulting from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, scour of existing marshes due to an increase in tidal prism following breaching, and flooding following breaching of levees. Flooding due to breaching at tidal restoration sites will result in temporary loss of habitat, at least until new wetland habitat is restored. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of the giant garter snake. Rather, the project is likely to have a net benefit to the species by creating extensive marshes providing a diverse mosaic of wetland habitats, thus contributing to its recovery. Critical habitat has not been designated for this species, and thus these actions will not result in adverse modification of critical habitat.

California clapper rail. The 2008 Amendment conservation actions are likely to adversely affect the California clapper rail due to the potential for minor loss of habitat and nests, eggs, and young resulting from grading, excavation, placement of fill for levees or berms, movement of

heavy equipment, vehicles, and project personnel, and scour of existing marshes due to an increase in tidal prism following breaching. Disturbance of active nests, possibly leading to the abandonment of nests, eggs, and young, could occur due to restoration and monitoring activities adjacent to breeding habitat. However, the diked marshes in which these restoration actions will occur do not provide habitat for the species, and these actions will result in restoration of extensive, high-quality tidal marsh habitat for the species that more than offsets any temporary, small-scale adverse effects. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of the California clapper rail. Rather, the conservation actions will have a substantial net benefit to the species, thus contributing to its recovery. Critical habitat has not been designated for this species, and thus these actions will not result in adverse modification of critical habitat.

Western snowy plover. The 2008 Amendment conservation actions are likely to adversely affect the western snowy plover due to the potential for disturbance of nesting plovers (possibly leading to the abandonment of nests, eggs, and young) in adjacent areas, and the potential loss of plover nests, eggs, or young due to grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and flooding after ponds are breached, if breeding plovers are present during restoration implementation. However, the diked marshes in which these restoration actions will occur do not currently provide habitat for the species. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of the western snowy plover. Critical habitat is not present within the action area, and thus these actions will not result in adverse modification of critical habitat.

California least tern. The 2008 Amendment conservation actions are likely to adversely affect the California least tern due to the potential for disturbance of nesting terns (possibly leading to the abandonment of nests, eggs, and young) in adjacent areas, and the potential loss of tern nests, eggs, or young due to grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, and flooding after ponds are breached, if breeding California least terns are present during restoration implementation. However, the diked marshes in which these restoration actions will occur do not currently provide habitat for the species. With implementation of BMPs to avoid and minimize impacts, any adverse effects on this species would be minor, and the conservation actions will not jeopardize the continued existence of the California least tern. Rather, tidal restoration conservation actions could potentially increase prey resources for the piscivorous least tern, and thus tidal restoration could benefit the species by improving prey abundance and foraging opportunities. Critical habitat is not present within the action area, and thus these actions will not result in adverse modification of critical habitat.

Salt marsh harvest mouse. The 2008 Amendment conservation actions are likely to adversely affect the salt marsh harvest mouse due to the potential for loss of habitat and individuals

resulting from grading, excavation, placement of fill for levees or berms, movement of heavy equipment, vehicles, and project personnel, flooding/drowning following breaching of levees, and scour of existing marshes due to an increase in tidal prism following breaching. Flooding due to breaching at tidal restoration sites will result in temporary loss of habitat, at least until sedimentation has elevated the restored marshplain to suitable elevations for colonization by pickleweed. Eventually, these actions will result in restoration of tidal marsh habitat for the species that more than offsets any temporary, small-scale adverse effects. Thus, the conservation actions will not jeopardize the continued existence of the salt marsh harvest mouse. Rather, the conservation actions will have a substantial net benefit to the species, thus contributing to its recovery. Critical habitat has not been designated for this species, and thus these actions will not result in adverse modification of critical habitat.

Delta smelt. The 2008 Amendment conservation actions are likely to adversely affect the delta smelt due to the potential for increased turbidity and suspended sediment, and a risk of toxic spills during construction, and a risk of creation of aquatic habitat with poor water quality and conditions suitable for non-native aquatic plants and predatory fish species. However, these conservation actions are specifically intended to increase habitat, enhance existing habitat conditions, improve access to habitat, and protect individual fish. Monitoring and adaptive management will be conducted as needed to ensure that these actions provide the benefits to fish such as delta smelt that are intended. Thus, although minor adverse effects on this species will occur, the conservation actions will not jeopardize the continued existence of the delta smelt. Designated critical habitat for the delta smelt is present within the action area, but the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat. Rather, the conservation actions will have a substantial net benefit to the species, thus contributing to its recovery.

Longfin smelt. The 2008 Amendment conservation actions are likely to adversely affect the longfin smelt due to the potential for increased turbidity and suspended sediment, and a risk of toxic spills during construction, and a risk of creation of aquatic habitat with poor water quality and conditions suitable for non-native aquatic plants and predatory fish species. However, these conservation actions are specifically intended to increase habitat, enhance existing habitat conditions, improve access to habitat, and protect individual fish. Monitoring and adaptive management will be conducted as needed to ensure that these actions provide the benefits to fish such as longfin smelt that are intended. Thus, although minor adverse effects on this species will occur, the conservation actions will not jeopardize the continued existence of the longfin smelt. Rather, the conservation actions will have a substantial net benefit to the species, thus contributing to its recovery. Critical habitat has not been designated for this species, and thus these actions will not result in adverse modification to designated critical habitat.

Sacramento River winter-run Chinook salmon. The 2008 Amendment conservation actions are likely to adversely affect the Sacramento River winter-run Chinook salmon due to the potential for increased turbidity and suspended sediment, and a risk of toxic spills during

construction, and a risk of creation of aquatic habitat with poor water quality and conditions suitable for non-native aquatic plants and predatory fish species. However, these conservation actions are specifically intended to increase habitat, enhance existing habitat conditions, improve access to habitat, and protect individual fish. Monitoring and adaptive management will be conducted as needed to ensure that these actions provide the benefits to fish such as winter-run Chinook salmon that are intended. Thus, although minor adverse effects on this species will occur, the conservation actions will not jeopardize the continued existence of the winter-run Chinook salmon. Designated critical habitat for the winter-run Chinook salmon is present within the action area, but the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat. Rather, the conservation actions will have a substantial net benefit to the species, thus contributing to its recovery.

Central Valley spring-run Chinook salmon. The 2008 Amendment conservation actions are likely to adversely affect the Central Valley spring-run Chinook salmon due to the potential for increased turbidity and suspended sediment, and a risk of toxic spills during construction, and a risk of creation of aquatic habitat with poor water quality and conditions suitable for non-native aquatic plants and predatory fish species. However, these conservation actions are specifically intended to increase habitat, enhance existing habitat conditions, improve access to habitat, and protect individual fish. Monitoring and adaptive management will be conducted as needed to ensure that these actions provide the benefits to fish such as Central Valley spring-run Chinook salmon that are intended. Thus, although minor adverse effects on this species will occur, the conservation actions will not jeopardize the continued existence of the Central Valley spring-run Chinook salmon. Designated critical habitat for the spring-run Chinook salmon is present within the action area, but the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat. Rather, the conservation actions will have a substantial net benefit to the species, thus contributing to its recovery.

California Central Valley steelhead. The 2008 Amendment conservation actions are likely to adversely affect the California Central Valley steelhead due to the potential for increased turbidity and suspended sediment, and a risk of toxic spills, during construction, and a risk of creation of aquatic habitat with poor water quality and conditions suitable for non-native aquatic plants and predatory fish species. However, these conservation actions are specifically intended to increase habitat, enhance existing habitat conditions, improve access to habitat, and protect individual fish. Monitoring and adaptive management will be conducted as needed to ensure that these actions provide the benefits to fish such as Central California Central Valley steelhead that are intended. Thus, although minor adverse effects on this species will occur, the conservation actions will not jeopardize the continued existence of the California Central Valley steelhead. Designated critical habitat for the California Central Valley steelhead is present within the action area, but the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat. Rather, the conservation actions will have a substantial net benefit to the species, thus contributing to its recovery.

Central California Coast Steelhead. The 2008 Amendment conservation actions are likely to adversely affect the Central California Coast steelhead due to the potential for increased turbidity and suspended sediment, and a risk of toxic spills, during construction, and a risk of creation of aquatic habitat with poor water quality and conditions suitable for non-native aquatic plants and predatory fish species. However, these conservation actions are specifically intended to increase habitat, enhance existing habitat conditions, improve access to habitat, and protect individual fish. Monitoring and adaptive management will be conducted as needed to ensure that these actions provide the benefits to fish such as Central California Coast steelhead that are intended. Thus, although minor adverse effects on this species will occur, the conservation actions will not jeopardize the continued existence of the Central California Coast steelhead. Designated critical habitat for the Central California Coast steelhead is present within the action area, but the 2008 Amendment conservation actions will not result in adverse modification of designated critical habitat. Rather, the conservation actions will have a substantial net benefit to the species, thus contributing to its recovery.

Green sturgeon. The 2008 Amendment conservation actions are likely to adversely affect the green sturgeon due to the potential for increased turbidity and suspended sediment, and a risk of toxic spills during construction, and a risk of creation of aquatic habitat with poor water quality and conditions suitable for non-native aquatic plants and predatory fish species. However, these conservation actions are specifically intended to increase habitat, enhance existing habitat conditions, improve access to habitat, and protect individual fish. Monitoring and adaptive management will be conducted as needed to ensure that these actions provide the benefits to fish such as green sturgeon that are intended. Thus, although minor adverse effects on this species will occur, the conservation actions will not jeopardize the continued existence of the green sturgeon. Rather, the conservation actions will have a substantial net benefit to the species, thus contributing to its recovery. Critical habitat has not been designated for this species, and thus these actions will not result in adverse modification to designated critical habitat.

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