MADERA IRRIGATION DISTRICT WATER SUPPLY ENHANCEMENT PROJECT

FINAL ENVIRONMENTAL IMPACT STATEMENT

Appendix B: U.S. Fish and Wildlife Service Final Biological Opinion

June 2011

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Room W-2605
Sacramento, California 95825-1846

In reply refer to:
81420-2008-F-0279-1

APR 26 2011

Memorandum

To: Michael P. Jackson, P.E., Area Manager, Bureau of Reclamation, South-Central California Area Office, Fresno, California

From: Susan Moore, Field Supervisor, Sacramento Fish and Wildlife Office, Sacramento, California

Subject: Final Biological Opinion on the Effects to Nine Listed Species from the Bureau of Reclamation and Madera Irrigation District's Water Supply Enhancement Project, Madera County, California

This memorandum responds to your memorandum dated April 21, 2008, requesting formal consultation with the U.S. Fish and Wildlife Service (Service) on the Bureau of Reclamation (Reclamation) and Madera Irrigation District (MID) Water Supply Enhancement Project (proposed project) in Madera County. Reclamation made a determination that the proposed project is likely to adversely affect the federally-listed endangered San Joaquin kit fox (*Vulpes macrotis mutica*), Fresno kangaroo rat (*Dipodomys nitratoides exilis*), blunt-nosed leopard lizard (*Gambelia sila*), vernal pool fairy shrimp (*Branchinecta lynchi*), conservancy fairy shrimp (*Branchinecta conservatio*), palmate-bracted bird's beak (*Cordylanthus palmatus*), and Greene's tuctoria (*Tuctoria greenei*); and the federally-listed threatened California tiger salamander (*Ambystoma californiense*), valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), and vernal pool tadpole shrimp (*Lepidurus packardi*). Reclamation also made a determination that the proposed project is not likely to affect the federally-listed threatened giant garter snake (*Thamnophis gigas*).

After reviewing the information contained in the April 21, 2008 memorandum, the Service responded on May 20, 2008 to Reclamation's request with a list of further information that was needed before consultation could begin. Reclamation responded to the Service's May 2008 memorandum on August 4, 2008. As a result of working through the information requested, Reclamation determined that the effect determinations should be changed for two species— the giant garter snake would not be affected because no suitable habitat is present at the project location, but the proposed action may adversely affect the Conservancy fairy shrimp (added above). Subsequent revisions to the project (relocated lift stations) have removed the potential for there to be an effect to elderberry shrubs, the host plant for Valley elderberry longhorn beetle.

TAKE PRIDE IN AMERICA

After reviewing information available to them, and coordinating with known experts for the species, Reclamation determined that the WSEP would have no effect on San Joaquin Orcutt grass (*Orcuttia inaequalis*), hairy Orcutt grass (*Orcuttia pilosa*) because the action area is outside of the known range for these species, and northern hardpan vernal pools, which is habitat for these species, do not occur on Madera Ranch. Reclamation also determined that California red-legged frog (*Rana draytonii*) and giant garter snake would not be affected by the WSEP because there is no suitable habitat for either of these species in the action area.

Between October 2008 and the present, the Service has worked closely with Reclamation, MID, the California Department of Fish and Game (CDFG), the Corps of Engineers (Corps), and the Environmental Protection Agency (EPA) to refine the project to define the 'Least damaging practical alternative' for the Corps and to avoid or minimize effects to sensitive areas and protected species.

We received your latest request for formal consultation on February 23, 2009. This response has been prepared pursuant to section 7 of the Endangered Species Act of 1973 (Act), as amended (16 U.S.C. 1531 *et seq.*), and in accordance with the regulations governing interagency consultations (50 CFR §402). Reclamation is requesting this consultation on behalf of the contractors that will be storing and selling water as part of the proposed action and the U.S. Army Corps of Engineers (Corps) which is evaluating this project pursuant to Section 404 of the Clean Water Act. On January 7, 2011, Reclamation and MID provided the Service with a complete, updated Biological Assessment, Appendices, and Figures. And on April 21, 2011, MID provided a revision to the project to incorporate wildlife crossing structures for the canals within the mitigation areas. This latest information and the impact analysis have been used to prepare this biological opinion.

The proposed action involves constructing (excavating) 323 acres of recharge basins (permanent loss) and installing approximately 81,854 linear feet of delivery and recovery canals (permanent loss), and 79,680 linear feet of roadway (permanent loss) improvements to deliver water to 550 acres of natural swales that will function as recharge basins, excavating four settling basins (totaling 55 acres) to regulate flows into the recharge swales, and installing five soil berms to direct recharge flows. Reclamation has assumed that lateral saturation associated with flooding the swales is likely to amount to an increase of approximately 20-percent in the wetted area. However, the actual distance that water will move laterally will depend on the depth, duration and frequency of the inundation events. In addition, the proposed action involves installing 87,776 linear feet of recovery pipelines (temporary impacts). In addition, there will be 49 recovery wells installed initially affecting approximately 50 acres. However, the finished wells will be on 20 foot by 20 foot well pads surrounded by chain link fence.

Construction related to the creation and expansion of the canal system, construction of the access and maintenance roads, and creation of the recharge basins will result in the permanent loss or significant alteration (*e.g.*, excavation, conversion from natural grassland) of 454 acres of annual grasslands, alkali grassland, alkali rain pool, vernal pool and freshwater marsh, and cultivated lands. Construction related to installing 87,776 linear feet of recovery pipelines and installing 49 new recovery wells will result in temporary impacts to 326 acres of annual grasslands and alkali grassland. To compensate for impacts to vernal pool habitats resulting from the construction and operation of the project, MID will be creating a vernal pool complex on 50 acres of annual and alkali grassland. All components of the construction-related disturbance (*e.g.*, ground excavation, equipment noise, human presence) will have a direct effect on one or more of the federally listed species within the action area.

Consultation History

September 28, 2007: Pursuant to the requirements of the National Environmental Policy Act, Reclamation published a Notice of Intent (NOI) to prepare an Environmental impact Statement and Notice of Public Scoping Meetings in the Federal Register for the Madera Irrigation District Water Supply Enhancement Project (WSEP).

October 24, 2007: Reclamation, the Service, and representatives of MID have the first of several meetings on the project. The Service recommends that California Department of Fish and Game (CDFG) be invited to future meetings.

Oct 2007 – Dec 2008: Regularly scheduled meetings and conference calls continue throughout the remainder of 2007 and 2008.

November 5, 2007: MID sent a letter to Reclamation notifying Reclamation that they (MID) meet the definition of an applicant and will participate in the consultation and Biological Opinion review process as such.

November 19, 2007: Reclamation responds to MID, with a copy to the Service, acknowledging that MID is an applicant. Reclamation explained that pursuant to 50 CFR §402.14(g)(5), the Service does not work directly with or take comments directly from the applicant without the knowledge or consent of the action agency.

December 15, 2007: The Service commented on the NOI with a list of potentially adversely affected species, and several recommendations and concerns regarding both impacts to federally threatened and endangered species and surveys for these species.

January 2, 2008: The Service commented on an environmental assessment prepared by Reclamation's Mid-Pacific Region office for a pilot project related to the WSEP. The Service expressed concern that a consultation under section 7 of the Act was needed for the pilot project.

March 10, 2008: Reclamation's Mid-Pacific Region responded to the Service's January 2, 2008 memo by stating that Reclamation's determination of no effect was appropriate for the pilot project.

April 21, 2008: Reclamation sent a biological assessment to the Service with a request for consultation on ten federally listed species for the WSEP.

May 20, 2008: The Service responded to Reclamation's request with a list of further information that was needed before consultation could begin.

August 4, 2008: Reclamation responded to the Service's May 20, 2008 memorandum. As a result of working through the information requests, Reclamation determined that the effects determination should be changed for two species. The giant garter snake would not be affected, but the proposed action may adversely affect the Conservancy fairy shrimp.

October 20, 2008: The Service requested additional information that was needed before consultation could begin.

February 23, 2009: Reclamation's request for formal consultation is received by the Service.

May 8, 2009: Reclamation discovered that, in the area of the pilot project, kangaroo rat burrows were underwater in pilot project swales. The pilot project had ended at this point and the water was from another source not related to Reclamation. In response, Reclamation's Mid-Pacific Regional office canceled a planned extension of the expired pilot project.

May 13, 2009: Reclamation responds to the Service's October 20, 2008 request.

May 2009-August 2010: Reclamation, MID representatives, the Service, the Corps, CDFG, and eventually the Environmental Protection Agency met in person or conducted several conference calls. The proposed action is reduced in size due to the need to propose only the Least Environmentally Damaging Practicable Alternative, pursuant to section 404 of the Clean Water Act.

July 19, 2010: Reclamation, MID and their representatives, the Service, and CDFG conduct a site visit to gain information needed to help select recharge basins sites that can avoid burrows potentially used by blunt-nosed leopard lizards.

July 2010 – Present: Conference calls and coordination continued

January 7, 2011: Reclamation provides final Biological Assessment for Madera Irrigation District Water Supply Enhancement Project, Madera County, California

January 31, 2011: Service provides draft Biological Opinion (Opinion) (received February 1, 2011) to allow Reclamation the opportunity to review our biological opinion for accuracy and clarity and to assure the project can be implemented to include our biological opinion.

March 16, 2011: Reclamation provided consolidated comments on the draft Opinion from MID and CDFG.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

Background The purpose of the proposed federal action is to meet a portion of MID's current and future water storage needs, enhance water supply reliability and flexibility by using the space underground for surface water storage (water banking), reduce aquifer overdraft, and encourage conjunctive use in the region as a means toward regional self-sufficiency.

To meet these project purposes, MID proposes to implement the Madera Irrigation District Water Supply Enhancement Project (WSEP), by which MID would bank a portion of their CVP water from the San Joaquin and Fresno Rivers and other non-CVP water in the aquifer underlying Madera Ranch. Water would be banked in the aquifer, and 10 percent of the water would be left in the aquifer to reduce local overdraft problems. In order for MID to fully implement the WSEP, federal approval to bank a portion of MID's CVP water supply outside their service area and an MP-620 permit to alter a federal facility (24.2 Canal) is needed (MID has paid off the facility but title has not yet been transferred, therefore, a permit is still required).

Currently, farmers in MID's service area use a combination of groundwater and surface water, and during dry and critically dry years there is not adequate surface water to meet the water demand. In these years, groundwater pumping increases substantially, and the amount of groundwater that has been pumped from the aquifer in the vicinity of Madera Ranch has exceeded the amount of water that has recharged the aquifer, resulting in groundwater overdraft. Even in wet years, the groundwater basin is in severe overdraft because groundwater pumping is steadily increasing for agricultural and municipal and industrial uses. This overdraft has caused the water table to decline and groundwater quality to degrade and has resulted in excess space underground that can be used to bank surface water. In the vicinity of Madera Ranch, the water table has declined more than 90 feet over the last 60 years. These conditions have made it increasingly expensive for farmers to pump groundwater. Additionally, in many years, MID has been unable to deliver sufficient surface water to farmers because water is available primarily during the early months of the year when irrigation demand is low, and often water is available only for short periods of time during the growing season.

MID has been working toward securing federal funds to assist in the cost of purchasing Madera Ranch and construction of the WSEP. On March 30, 2009, the Omnibus Public Lands Management Act of 2009 became law (Public Law 11-111; H.R. 146-308). Section 9102 of the Omnibus Act includes the "Madera Water Supply Enhancement Project, California" which, among other things, authorized the Secretary of the Interior, acting pursuant to the Federal reclamation laws (Acts of June 17, 1902; Stat. 388), and Acts amendatory thereof or supplementary thereto, to enter into a cooperative agreement through the Bureau of Reclamation and MID for the support of the final design and construction of the WSEP. MID is currently pursuing federal funding through the appropriations process.

Proposed Action

Reclamation would authorize a total banking capacity of 250,000 af of MID CVP water outside MID's existing CVP Place of Use and issue an MP-620 permit for the alteration of Reclamation-owned facilities (Lateral 24.2). Funding may also be provided by Reclamation under the Omnibus Public Land Management Act of 2009, the Policy and Program Services, Challenge Grant Program: Recovery Act of 2009 Water Marketing and Efficiency Grants, or any other funding source. Regardless of whether this funding is acquired, the project components and associated effects would be the same. The U.S. Army Corps of Engineers (Corps) would issue a standard individual permit to MID pursuant to section 404 of the Clean Water Act.

The Proposed Action (as described in Reclamation's Final Environmental Impact Statement) was developed with input from the Corps, CDFG and the Service. The Proposed Action represents a scaled-back version of the original MID proposal that uses fewer swales to minimize effects to vernal pools and limits the number of recharge basins to the number needed for the project to be practicable. The Proposed Action will complete the water bank in two phases— Phase 1 will involve constructing 81,854 linear feet of necessary delivery infrastructure improvements (except for the Section 8 canal southwest extension), constructing 79,860 linear feet of access roadway, using 550 acres of natural swales for recharge, constructing 55 acres of recharge or regulating basins, and installing at least five soil berms to assure that recharge flows are directed into the swales. Phase 2 will involve constructing two recharge basins totaling 323 acres and constructing 49 pumps and installing 87,776 linear feet of pipeline facilities for the recovery of banked water.

Phase 1 Facilities

MID would implement Phase 1 to increase the capacity of existing MID conveyance facilities to deliver water to Madera Ranch facilities. Phase 1 would primarily use natural swales as recharge areas.

Phase 1 activities would involve reconditioning and extending approximately 81,854 feet of canals to provide at least 200 cubic feet per second (cfs) of conveyance capacity into Madera Ranch and 20 to 50 cfs for the canal network on the property; excavating four recharge basins totaling 55 acres on current agricultural land to regulate flow into the swales, remove sediment, and provide some recharge; application of recharge flows to approximately 550 acres of swales; and integration of approximately 2,600 acres of Madera Ranch row crops and vineyards into an in-lieu recharge program in which surface water periodically would be provided in lieu of groundwater pumping subject to approval by the Madera Ranch Oversight Committee (MROC).

Recharge Facilities

Recharge Basins Phase 1 would involve construction of four basins totaling approximately 55 acres in order to help regulate flows, allow settling of sediments before application of water to swales, and provide some recharge capacity. The four Phase 1 recharge basins are located on currently active agricultural land in Sections 1, 13, 21, and 22. The basins have been designed with 1.5:1 to 2:1 interior side slopes and average depths of 4 to 5 feet, surrounded by low earthen dikes/berms created from the dirt excavated from the basin.

Swale Recharge Areas The Proposed Action would entail diversion of water into approximately 550 acres of swales. The water would be conveyed to Madera Ranch through the existing and upgraded MID conveyances and to the swales through the existing, rehabilitated, and new ditches described above. At the head of each swale, a manually operated farm turnout (equipped with a gate valve and totalizing flow meter) would be installed to regulate and measure the flow into each swale. Several turnouts currently exist on Gravelly Ford Water District's Gravelly Ford Canal and these would be replaced and several new ones will be added. Flows at each turnout, based on pilot studies, would be no greater than 20 cfs and would average 5 cfs at the turnout. Maximum overall flows would be around 1 cfs per acre of application. .

Phase 2 Facilities

Phase 2 would expand the areas used to recharge, develop wells and piping to recover the banked water, and install pumps to deliver the recovered water.

Phase 2 activities for recharge and recovery facilities would involve additional upgrades to 16,896 feet of existing canals, constructing 323 acres of new on-site recharge basins and canals, use of up to 15 existing wells for recovery, installation of up to 49 new recovery wells, and installing 81,579 feet of recovery pipelines over several years to provide 200 cfs of recovery capacity. In addition 12 lift stations will be constructed on MID canals and one lift station on Gravelly Ford Canal (in phases over several years) to provide 200 cfs of pump-back capacity into the MID service area.

Recharge Basins It is anticipated that 323 acres of recharge basins will be constructed west of Gravely Ford Canal. Following pre-construction surveys, MID would begin construction of the basins. Excavation of basins varying from 4 to 5 feet deep and would be designed with 1.5:1 to 3:1 interior side slopes. After excavation, each basin would be shallow-ripped or disked by construction equipment in order to break up compaction of the bottom soils in the recharge basin. Low earthen dikes would be constructed around the recharge basins using excavated materials. Topsoil would be segregated during excavation and spread over the berm and construction disturbance areas to promote reestablishment of vegetation. Excess soil removed during excavation would be managed to ensure that top layers are stockpiled, excavated soils would be mounded between basins, and stockpiled topsoil would be placed on top of the soil pile.

Construction

Reconditioning (upgrading) activities include excavating material from canal bottoms and sides to restore or expand the capacity of the feature so that it can accommodate the delivery of 200 cfs of water to the project. Construction to extend or expand the on-ranch canal system will involve excavating soil to create canals with a top width of between 20 and 25 feet, depending on the capacity. Upgrading the connection would involve draining the canals; excavating mud or silt from the bottom of the canals, and storing the wet material on site or transporting it to a storage site; excavating the canals to a sufficient width and depth to provide adequate capacity; transporting the excavated material to Madera Ranch for use as fill required by other proposed construction; and installing piping for road crossings. Roads to access the canal system, recharge basins, and recovery wells will typically be 20-feet wide and will traverse the grassland habitats. Construction and maintenance activities that will result in ground disturbance will be limited to portions of the year when seasonal above ground activity is correlated with weather conditions, primarily temperature. Lizards are most active on the surface when air temperatures are between 74° and 104° F, with surface soil temperatures between 72° and 97° F— typically between May 1 and September 30

Recovery Facilities

Recovery facilities include recovery wells, pipelines, access roads, and lift stations.

Construction of Recovery Wells The recovery wells would be constructed by drilling to a depth of approximately 300–320 feet below ground surface. The wells would be gravel-packed between the casings and bore holes to maximize efficiency. Construction techniques would involve drilling, flushing, development, and testing to maximize well efficiency and longevity. The screen opening size, screen length, and screen depth of each well would be determined in the field by a registered geologist. Each well would be fenced within an enclosure of approximately 20- feet by 20-feet to allow most areas of Madera Ranch to continue to be grazed by cattle.

Installation of Recovery Pipelines The recovery pipelines would be constructed by trenching rectangular ditches wide enough to lay the pipe. Trenching would be performed by backhoes, track hoes, or trenching machines. Soil would be temporarily sidecast within the construction corridor and pushed back into the trench once the pipeline is in place.

Construction of Recovery Lift Stations Lift stations would consist of reinforced concrete check structures with pumping equipment to reverse flow. The gates would allow control of flows of surface water to Madera Ranch and would be closed to accommodate reverse flows when recovered water is being pumped back to MID's customers. Lift stations would be constructed in three phases, requiring about 90 to 120 days for each phase. Each lift station would require a work area of about 0.25 acre that would be disturbed during construction. The final area occupied by the structure would be about 2,500 square feet. The total area permanently affected by the lift stations would be approximately 1.2 acres.

Staging Areas

MID would use its existing off-ranch facilities for the long-term storage and maintenance of materials and equipment, and Madera Ranch has a central headquarters area with equipment laydown areas and storage buildings. MID would use these facilities as needed to store equipment and materials that would be used to construct, maintain, and operate the WSEP.

Maintenance

Maintenance corridors would include new roads in the recharge basin area and areas with heavy disturbance, and unimproved routes in grassland areas. The maintenance corridors would be configured to take advantage of existing farm roads, fence lines, farmed areas, and recharge basin areas. Minimal maintenance on the access roads and corridors would be required. MID has indicated that maintenance activities will include grading and fill activities to repair ruts and pot-holes. The maintenance roads may require maintenance following wet winters if portions of the roads wash out or become impassable. Maintenance corridors through undisturbed grassland areas would not be graded or gravel-packed. To minimize effects on grassland habitat, no maintenance of the corridors in grassland areas is proposed. MID has committed to conduct maintenance activities along the access roads to the May 1 thru September 30 period required for initial construction activities.

Maintenance of the Section 8 Canal, Cottonwood Creek, the 24.2 Canal, the Main No. 1 Canal, and the on-ranch conveyance ditches and canals would be consistent with maintenance of most water infrastructure in the San Joaquin Valley. Canals and ditches on MID property would be unlined but would be kept clear of woody vegetation. Channels would require cleaning every several years. Each channel would be cleaned using mechanized dredging. Cleaning would be scheduled during periods when the canals are not in operation. Banks of channels would be kept clear of brush and trees, and small mammal burrows would be filled to minimize erosion of the channel banks.

Any evidence of small mammal burrows would be monitored and burrows filled in to reduce the possibility of damage, leakage, and potential collapse of canal banks. Maintenance roads parallel to the canals and ditches would have all-weather surfaces; and vegetation would be controlled.

Access to canal bottoms would be by intermittent ramps that would allow mechanical equipment access into the canals for cleaning. Deeper sections of canals would be cleaned using small mechanical equipment such as rubber-tired front-end loaders or "bobcats." Materials removed from the canal bottoms would be disposed of by legal means, including spreading on farmland as allowed or on the maintenance areas of the groundwater bank property. Shallow sections of canals or ditches may be cleaned out using Gradall excavators that would work from access roads. The frequency of cleaning operations would be determined by what is necessary to maintain reasonable flow regimes in the canals.

Recharge Facilities Recharge swales and basins would stand idle when water is not available for banking. No maintenance would be performed in swales during these times, but recharge basins may be scarified as described below. During operation of recharge basins, it may be necessary to apply algicide or other chemicals to keep vegetation in check and to minimize algae growth. Algicides would not be used within natural swales used for recharge. Basin operation would require infrequent delivery of miscellaneous repair equipment, usually in smaller trucks such as non-semi, three-axle rigs. On average, after 5 years of actual use, basin bottoms would be scarified to remove the thin layer of low permeability material that is expected to develop over time. Other maintenance activities would be conducted as necessary.

Recovery Wells Wells, meters, pumps, and appurtenances would be maintained during periods when recovery is not in progress to allow ready startup when a bank participant requests water. The wells are expected to run for up to 5 operating years before needing maintenance or repair. The well pumps are expected to operate for at least 10 years before requiring maintenance or repair. Wells would be reworked on an average 20-year cycle.

Recovery Pipelines Nominal maintenance of recovery pipelines would be required. The anticipated life of recovery pipelines is approximately 50 years; however, in the event of a break in a pipeline or excessive leakage, segments of a pipeline would need to be replaced. Depending on the size and length of the segment to be replaced, the pipeline would be either mechanically or hand-excavated.

Water Banking MID would bank a portion of its CVP contract water supply made available by contracts with Reclamation (Friant Division and Hidden Unit supplies), CVP uncontrolled flows provided under temporary contract and MID's pre-1914 non-CVP water rights supply. It is expected that average annual water available for banking would be approximately 20,000 af (15,000 af with river restoration) with wet years providing up to 55,000 af. Water typically would be banked from mid-October through mid-April, depending on water-year type and availability. Large amounts of water are unlikely to be banked during the summer because MID's current system is being used to convey water to farmers. However, with the increased delivery capacity available due to the expansion of the canals leading to the proposed bank, there is the potential for delivering water to be banked during the summer months. This summer water could also consist of agricultural return water flowing off of croplands upslope from the bank.

Water would be delivered into the distribution ditches, swales, and recharge basins through the enlarged Section 8 Canal (converting to a pipeline within Madera Ranch), the 24.2-19.5 lateral canal, the Gravelly Ford Canal, and Cottonwood Creek. Parshall flumes and weirs would be installed in these conveyance features to regulate and measure flows in the same fashion as has been performed throughout the MID and Friant systems for decades. Upstream recharge basins would be used for sedimentation control. Flows through ditches, swales, and basins would be regulated in accordance with monitoring and operating criteria designed to prevent overflows and unacceptably high water table elevations beneath adjoining properties. MID would control upstream, off-site flows to avoid spillage in the same manner that current water operations are conducted.

Flows in the swales would be constrained by acreage and the canal's capacity to deliver water to the swales. Water depths could range from several inches to several feet depending on the topography of the swales, percolation rates, and the amount of water being applied. Flows in the canals would be constrained by capacity, and recharge for banking in the canals, including Gravelly Ford Canal, would depend on the percolation rates. During water years with limited water available for banking, MID would use canals and selected swales to bank available supplies. The swales would be selected based on readily available canal delivery locations and other management needs. Flows to the recharge basin ponds, should they be needed, would be similarly constrained by seasonal water availability and delivery capacity.

In general, when doing initial operations, MID would step up the flow into a swale in discrete increments (typically around 2-5 cfs per increment) and once the inundation for that flow has stabilized (typically within one day), MID would map the wetted extent of the swales using a geographic positioning system (GPS). MID would then step up to the next higher flow increment and repeat the process. MID followed this process during the pilot project (between January 2005 until April 2009) until they reached the maximum wetted extent. These flow-versus-inundated acreage data pairs allowed MID to build a "rating curve" for a swale. This curve allowed MID to predict very accurately the wetted area given a certain flow. MID would then repeat the construction of the rating curves approximately two to three more times during a recharge season so that MID can observe how the swales perform over time.

Under the Proposed Action, MID could use the entire annual recovery capacity (55,000 af) of the facilities for its agricultural customers in some years. If capacity is available after Madera County needs have been met, MID's banking facilities could be used by regional customers. Potential participants would be required to provide their own water for banking and would take delivery of banked water through exchange. Participant water would be gravity delivered through MID conveyances for recharge through the proposed facilities.

Potential non-MID participation could result in a wide array of agreements, water rights amendments, transfers, or changes to the operation of existing non-MID facilities. However, the specific tenants, potential agreements, and other related actions are not reasonably foreseeable. Therefore, analysis of these potential elements would be remote and speculative. As a result, the environmental analysis presented in this document has been conducted without regard to the specific entities or organizations that may desire to bank water in the proposed facility. MID's Friant Division Long-Term contract with Reclamation does not provide for delivery of Millerton water to municipal or industrial users. However, there is a need for water storage by other Madera County water users. Other potential users would require separate environmental analysis and approvals, and would rely on their own water entitlements in using the proposed groundwater banking and recovery facilities.

Mitigation

MID has developed a draft management plan that describes future management issues associated with Madera Ranch related to grazing, water management, endangered species, vernal pools, and monitoring. MID has proposed that compensation (mitigation) for the effects to protected species and their habitats that will result from implementation of the Proposed Action could be accomplished on a mosaic of lands that would include approximately 2,357 acres of land managed to provide suitable habitat for the affected species, and an additional 3,456 acres that is the location of a significant portion of the recharge swales (350 of 550 acres). These lands will be managed primarily for recharge purposes, but will provide relatively natural lands between the swales that can provide habitat for the effected species and connects the two compensation parcels.

These effects include temporary impacts to 343 acres of grasslands from construction of the recovery wells and pipeline system and permanent impacts to 777 acres of annual grasslands and alkali grassland from canal and settling/recharge basin construction, and the loss of 550 acres of natural swales that are to be used as recharge basins. Mitigation for the loss of 3.3 acres of vernal pool habitat will be in the form of 7.0 acres of created vernal pools and preservation of vernal pools in the mitigation area. These created pools will be inoculated with cysts and seeds from other high quality vernal pools on site in accordance with Service-approved methods.

As stated in the biological assessment, MID's overall approach is to manage the property to achieve water banking, cattle production, and endangered species habitat (including mitigation) objectives. MID has developed a Mitigation and Management Plan (MMP) that describes two distinct management units, mitigation (compensation) lands and non-mitigation (non-compensation) lands, though the property will be managed with the overall intent of achieving multiple objectives. Lands in Area 1 and Area 2 are those areas where more prescriptive and regimented practices will occur; these areas are managed with the primary purpose of benefiting endangered species and will include a cattle grazing program to manage vegetation.

MID will create at least three canal crossings along Gravelly Ford Canal and 6 canal crossings along the Section 8 Canal Northern Extension; the width of the crossings will vary from approximately 16 feet along Gravelly Ford Canal to approximately eight feet along the Section 8 Canal Northern Extension. While making Gravelly Ford Canal improvements and installing the Section 8 Canal Northern Extension, MID will excavate slightly below the bottom grade of the canal to install a culvert and provide for a crossing to connect the habitat units. The area will be backfilled, covering the crossing with soil from the canal improvement. A similar concept will be employed for the Section 8 Canal Northern Extension, though the length of the pipe segment would be four to eight feet and because of the flat hydraulic grade one larger pipe may be used.

The required vernal pool creation/reestablishment also will occur on a portion of Compensation Area 2. Water banking and grazing will occur in mitigation Area 3, and the swales used for banking and facilities needed for banking will not count toward the mitigation area totals. Non-mitigation lands in Area 3 are those areas where less prescriptive and regimented practices will occur; these areas are managed with the primary purpose of banking water, with continued grazing and habitat maintenance for endangered species.

Environmental Commitments

The following environmental commitments related to biological resources were included in the project description by MID and they have committed that these measures will be implemented in association with construction activities for the Proposed Action. Addition commitments for other resource categories are described in the Biological Assessment and EIS/EIR prepared for this project.

Environmental Commitment BIO-1: Establish a Grasslands Conservation Easement
Mitigation for the loss of California annual grassland, alkali grassland, or Great Valley iodine bush scrub would consist of establishing a grasslands conservation easement at Madera Ranch over an area of habitat larger than the area subject to long-term degradation (2 acres conserved: 1 acre affected for swales) or permanent loss (3 acre conserved: 1 acre lost). MID also would implement a management plan to improve existing on-site habitat through grazing management and species monitoring.

Environmental Commitment BIO-2a: Preconstruction Surveys/Avoid Effects on Vernal Pools and Alkali Rain Pools
MID will minimize effects on species in this habitat by avoiding these wetlands to the extent practical. A buffer area will be established around suitable habitat for listed crustaceans in the action area, i.e., vernal pools. Buffer areas will be demarcated by installing fencing 250 feet from each occupied pool. A qualified biologist will flag the pools to be fenced, and temporary fences will be installed as the first order of work. Construction barrier fencing will be placed at the edge of the buffer areas. Temporary fences will be furnished, constructed, maintained, and later removed as shown on the construction plans, as specified in the special provisions, and as directed by the project engineer. Temporary fencing will be four feet high, orange, commercial-quality woven polypropylene. No construction activities will be permitted within the buffer zone (including staging or side casting of material) other than those activities necessary to erect the fencing. Erosion control measures will be employed adjacent to occupied listed crustacean habitat to prevent soil from eroding or falling into these areas. Natural/ biodegradable erosion control measures (e.g., straw wattles, hay bales) will be used. Plastic monofilament netting (erosion control matting) will not be allowed.

Environmental Commitment BIO-2b: Create, Restore, and/or Preserve Vernal Pools
MID will create, restore and/or preserve vernal pool habitat at Madera Ranch in an area protected under a conservation easement. Five acres of vernal habitat would be restored and/or preserved for each acre of vernal pool or alkali rain pool habitat lost as a result of activities associated with the Proposed Action (5 acres created:1 acre lost). MID anticipates that the approximate split of these acreages will be 3:1 preservation and 2:1 creation/restoration.

This ultimately will be determined based on wetland locations, soil conditions, and consultation with the Corps; soils, hydrology, vegetation, and species will be monitored. The performance standard for created vernal pools is to ensure the new vernal pools emulate the natural pools at Madera Ranch. Created vernal pools would have similar plant species composition and vegetation cover and invertebrate fauna as the vernal pools that are being removed by activities associated with the Proposed Action.

Success of the vernal pool creation would be assessed by comparing the pools with undisturbed natural vernal pools at Madera Ranch. Restored vernal pools will have similar success criteria. In addition, MID will comply with Reclamation's wetlands mitigation and enhancement policy, which focuses on protecting, restoring, and enhancing wetlands and ensuring no overall net loss of wetlands. Wetland mitigation creation and restoration sites will be monitored until it is proven successful to the Corps, Service, and CDFG. Mitigation sites must function for at least three years without human intervention.

Environmental Commitment BIO-3a: Avoid Effects on Iodine Bush Scrub
MID will locate the well and pipeline to avoid direct effects on iodine bush scrub habitat in the northern portion of Section 7 associated with construction activities. If wells and pipelines need to be constructed in this habitat, MID will conduct botanical surveys and mark plants to be avoided during construction.

Environmental Commitment BIO-3b: Survey for Sensitive (Listed) Plants
During Phase 1, two botanists will conduct visual surveys for palmate-bracted bird's beak, Green's tuctoria and other sensitive plant species in a 60-foot corridor (30 feet per side) along the proposed pipeline and canal alignments. These (protocol level [CDFG November 2009 protocol]) surveys will be conducted in April and July. Species information will be recorded in GPS. The results of the botanical surveys will be used to determine which avoidance, minimization or environmental commitments will be employed. If palmate-bracted bird's beak or Green's tuctoria are found, the population will be delineated with highly visible flagging tape or plastic fencing and avoided. If other sensitive species are found, MID will coordinate with permitting agencies to determine the feasibility of avoiding the population. During Phase 2, additional botanical surveys will be conducted in the area proposed for recharge basin creation. Complete visual surveys will be conducted in a similar manner in all areas proposed for permanent ground disturbance. If other sensitive species are found, MID, CDFG and the Service will coordinate to determine the feasibility of avoiding the population.

Environmental Commitment BIO-4a: Preconstruction Surveys for California Tiger Salamander
A Service-approved biologist will conduct preconstruction surveys for California tiger salamander in suitable aquatic and upland habitat. Before the start of ground-disturbing activities or vegetation removal, the approved biologist or biological monitor will survey the area to be affected that day for California tiger salamanders. The biologist also will examine any open trenches, which will have ramps or be closed when unattended, for the presence of salamanders. If a salamander is found in the construction area, the approved biologist will remove the animal from the area and release it into a suitable burrow at least 300 feet outside the construction area. The biologist will document the results of surveys on preconstruction survey log sheets, which will be kept on file at MID.

Environmental Commitment BIO-4b: Restrict Construction Activity in Suitable Aquatic and Upland Habitat for California Tiger Salamander to the Dry Season (April 1–November 1)[1]
To avoid and minimize potential mortality and injury of breeding and dispersing California tiger salamanders, construction will take place only during the dry season (between April 1 and November 1 or before the onset of the rainy season, whichever occurs first) in suitable aquatic and upland habitat for the species. Upland habitat is defined as all habitat within one mile of occupied or suitable aquatic habitat. Specifically, this measure applies to all pipeline construction on Madera Ranch and during work at all delivery canals. This measure does not apply to construction activities in gravel shoulders and heavily disturbed non-habitat areas where construction is confined entirely to areas devoid of upland grassland habitat.

Environmental Commitment BIO-4c: Fence the Construction Zone and Implement Erosion Control Measures in Areas Where Suitable Aquatic Habitat for California Tiger Salamander Is Present
The construction zone will be fenced in areas where suitable aquatic habitat for California tiger salamander is adjacent to the construction area. The purpose of the fence is to restrict construction equipment to the designated area only. Erosion control measures also will be implemented in these areas to prevent any soil or other materials from entering aquatic habitat. Locations of temporary fences and erosion control measures will be shown on the construction plans and will be reviewed by a qualified biologist. Construction barrier fencing will be installed along the edge of the work area as the first order of work. Temporary fences will be furnished, constructed, maintained, and later removed as shown on the plans, as specified in the special provisions, and as directed by the project engineer. No construction activities will be permitted outside the designated construction zone other than those activities necessary to erect the fencing. Erosion control measures will be installed adjacent to suitable aquatic habitat to prevent soil from eroding or falling into these areas. Natural/biodegradable erosion control measures (e.g., straw wattles, hay bales) will be used. Plastic monofilament netting (erosion control matting) will not be allowed because salamanders can be caught in this type of material.

Environmental Commitment BIO-5: Pre-Activity Surveys for Blunt-Nosed Leopard Lizard
The objective of the blunt-nosed leopard lizard surveys is to avoid take of blunt-nosed leopard lizard during use of the swales for water banking and construction of water delivery canals and other facilities. Specific measures for linear facilities and swales are described below.

Environmental Commitment Bio-5a: Install exclusion fencing and conduct clearance surveys and construction monitoring for blunt-nosed leopard lizards

Linear Facilities
A. Prior to construction of linear facilities in grassland and/or saltbush scrub/Valley sink scrub habitat and adjacent dirt roadways MID, in consultation and coordination with qualified wildlife biologists, shall create exclusion corridors based on habitat suitability and the need to create exclusion zones for burrows, scalds, and wetlands. Construction of linear facilities is restricted to May 1st through August 1st and may commence in areas only after blunt-nosed leopard lizard

1 This timeframe is only for the California tiger salamander, and would be coordinated with any timing restrictions for other species, including the blunt-nosed leopard lizard.

pre-construction surveys are completed. Pre-construction blunt-nosed leopard lizard surveys shall consist of the following minimum parameters:

1. Surveys for adult blunt-nosed leopard lizard shall be conducted between April 28th and July 1st and shall occur when the air temperature (as measured at 1-2 cm above the ground over a surface most representative of the area being surveyed) is between 25° C - 35° C (77° F – 95° F). Once the air temperature falls within the optimal range, surveys may begin after sunrise (once sun is high enough to shine directly on the ground surface being surveyed) and must end by 1400 hours or when the maximum air temperature is reached, whichever occurs first.
2. Time of day and air temperature shall be recorded at the start and end of each survey.
3. Surveys will not be conducted on overcast (cloud cover > 90 percent) or rainy days or when sustained wind velocity exceeds 10 mph (>3 on Beaufort wind scale).
4. Surveys shall be conducted on foot and transects shall be no larger than 10 meters wide, consist of a slow pace, and be conducted on a north-south orientation when possible.
5. Surveys shall be conducted for 12 days over the course of a 30 day period. Surveys shall be conducted for 4 consecutive days, weather permitting with at least one survey session consisting of a 4 consecutive day period.
6. The starting/ending locations of surveys should be modified/alternated to the extent practicable, but resulting in the same area surveyed. This is so that different portions of the site are surveyed at different time/temp periods.
7. Surveyors must be approved by the CDFG and the Service to conduct the blunt-nosed leopard lizard reconnaissance surveys. The survey crew conducting focused blunt-nosed leopard lizard surveys shall consist of no more than 3 Level I surveyors for every Level II surveyor. The names of every surveyor must be recorded for each survey day.
8. All herpetofauna observations shall be recorded/tallied. All blunt-nosed leopard lizard observations shall be recorded with GPS, time of observation, name of observer, sex (if evident), and lifestage (adult, juvenile, hatchling). If blunt-nosed leopard lizard is observed in association with or observed entering a particular burrow, burrow location (via GPS) should be recorded as well.
9. If a blunt-nosed leopard lizard is observed within such areas, consultation with CDFG must immediately occur. However, if blunt-nosed leopard lizard observations are made, blunt-nosed leopard lizard surveys should not be halted; the entire survey should be completed for the entirety of the construction footprint; continuing the surveys is important to maximize detections and to best help inform where the lizards occur and may not occur. Partial surveys cannot be used to inform whether or not avoidance can or will occur. (Hereafter 1- 9 collectively referred to as, "Blunt-nosed leopard lizard Pre-Construction Survey Parameters".)

B. Installation of Barrier - Within 3 days after blunt-nosed leopard lizard pre-construction surveys are completed, biologists shall oversee the creation an exclusion area by installing a non-gaping non-climbable barrier using a material approved by CDFG and the Service along 3 sides of the planned linear facility construction perimeter. The barrier installation shall be overseen by biologists who have blunt-nosed leopard lizard experience and who have been approved in advance by the Service and CDFG (hereafter, qualified blunt-nosed leopard lizard biologists).

The barrier fencing shall be installed perpendicular to the ground (vertical) and shall be sealed to ensure there are no gaps between segments or under the fencing. An example of possible suitable material can be found at http://www.ertecsystems.com/. Small mammal burrows and burrow complexes shall be excluded from the liner facility construction areas to the maximum extent practicable and a no disturbance buffer zone shall be established and clearly delineated from any burrows / burrow complexes. The day following the installation of the fencing, the qualified blunt-nosed leopard lizard biologists shall walk approximately 10 meter transects along the partially fenced linear facility construction area during the time of day when air temperatures fall within the optimum range for species detection, during the peak blunt-nosed leopard lizard activity season, and as outlined above. If no blunt-nosed leopard lizard are detected, the fourth side of fencing may be installed and MID may begin work within the fenced area. At least two CDFG and Service approved biologists will be present within the construction area when construction and other activities within the exclusion area are in progress.

C. Walking Surveys Throughout Construction - Throughout construction, the biologists shall conduct walking surveys of the construction area, looking for blunt-nosed leopard lizard. All open holes and trenches within habitat will be inspected at the beginning of the day, middle of the day, and end of day for trapped animals. If blunt-nosed leopard lizard are detected at any time and within any area of the basin construction site, biologists will halt all work, open a section of the exclusion fencing, and allow the lizard to leave the area on its own (no chasing, following, etc. can occur).

D. Inadvertent Entrapment Prevention - To prevent inadvertent entrapment of blunt-nosed leopard lizard or any other wildlife during the construction phase of the linear facilities, all excavated, steep-walled holes or trenches more than 2 feet deep shall be covered at the close of each working day by plywood or similar materials or provided with one or more escape ramps (with no greater than a 3:1 slope) constructed of earth fill or wooden planks. Before such holes or trenches are filled, they shall be thoroughly inspected for trapped animals by a qualified biologist. If a blunt-nosed leopard lizard is trapped, then it shall be allowed to escape on its own. In addition, all construction pipe, culverts, or similar structures with a diameter of 7.6 centimeters (3 inches) or greater that are stored at the construction site for one or more overnight periods will be thoroughly inspected for blunt-nosed leopard lizard before the pipe is subsequently moved, buried, or capped. If during inspection one of these animals is discovered inside a pipe that section of pipe shall not be moved until the animal has escaped on its own.

E. Construction Time - The permitted construction time is from one hour after sunrise to one hour before sunset, and two biological monitors shall also be active at all times when construction or other activities are in progress. The biological monitors shall survey the construction area during construction, scanning the ground for blunt-nosed leopard lizard and routinely checking excavated soils to ensure that blunt-nosed leopard lizard are not present. The biological monitors shall stop work if a lizard is found within the construction area until the lizard has been excluded from the work area.

F. Multiple Construction Areas - More than one linear facility construction area may be established and under construction at the same time provided the minimum number of biologists and biological monitors are present at each of the sites at all times during construction or other related activities.

G. Notification of Dead or Injured blunt-nosed leopard lizard - If any dead or injured blunt-nosed leopard lizard are observed on or adjacent to the construction site, or along the haul roads/travel routes for worker and/or equipment, regardless of assumed cause, CDFG and the Service shall be notified. The initial notification to CDFG and the Service shall include information regarding the location, species, and the number of animals injured or killed. Following initial notification, MID shall send CDFG and the Service a written report within 2 calendar days. The report shall include the date and time of the finding or incident, location of the carcass, and if possible provide a photograph, explanation as to cause of death, and any other pertinent information.

Recharge Basins
MID, in consultation and coordination with qualified a wildlife biologist, shall create appropriately sized recharge basin construction areas before construction of recharge basins in grassland and/or saltbush scrub/Valley sink scrub habitat and adjacent dirt roadways within the former center pivot areas of Section 16, 17, and 18 on Madera Ranch. Construction areas shall be prioritized initially by reconnaissance surveys no more than 60 days prior to any basin construction activities or ground disturbance to identify areas with the fewest burrows and least suitable habitat for blunt-nosed leopard lizard. Construction of basins will be restricted to May 1st through August 1st and may commence in areas identified through the above referenced reconnaissance surveys only after blunt-nosed leopard lizard pre-construction surveys are completed by way of the blunt-nosed leopard lizard Pre-Construction Survey Parameters. (See paragraph I.A. above).

The information gathered from these surveys will be used by CDFG to determine which habitat is most likely occupied and to identify appropriate exclusion areas. (Basins shall initially be planned to be sited in the former center pivot areas of Section 16, 17, and 18.) If no blunt-nosed leopard lizard is observed within 3 days after the completion of the blunt-nosed leopard lizard pre-construction survey, biologists shall create an exclusion area by installing non-gaping non-climbable barrier. The installation for such barrier shall comply with the installation guidelines listed above under linear facilities, and must be supervised by a qualified blunt-nosed leopard lizard biologist. (See paragraph I.B above.)

Construction of the recharge basins is permitted from one hour after sunrise to one hour before sunset. (See I.E above.) More than one percolation basin construction area may be establish and under construction at the same time provided the minimum number of biologists and biological monitors are present at each of the sites at all times during construction or other related activities. Throughout construction, Biologists shall conduct walking surveys of the construction area to determine whether there is any detection of the blunt-nosed leopard lizard. The survey procedures shall comply with paragraph I.C. listed above. Also during construction, all excavated, steep-walled holes or trenches more than 2 feet deep shall be covered as described under I.D above, to prevent inadvertent entrapment of blunt-nosed leopard lizard or any other wildlife.

Finally, if any dead or injured blunt-nosed leopard lizard are observed on or adjacent to the construction site, then MID must notified CDFG and the Service in accordance with the outline procedures listed above under I.G. If the blunt-nosed leopard lizard fully protected status is rescinded and an incidental take permit is granted, then these measures will not be required.

On-Ranch Ground Disturbing Facility Maintenance
MID will have an agency approved biologist review future ground disturbing facility maintenance work locations and sizes to evaluate the potential for effects to blunt-nosed leopard lizard. If the activity is in suitable habitat and could affect burrows, MID will conduct the work during the appropriate seasonal window and implement site-specific exclusion measures such as fencing and additional surveys as prescribed above for linear facilities.

Environmental Commitment Bio-5b: Conduct blunt-nosed leopard lizard and burrow surveys of swales proposed for inundation
MID will conduct blunt-nosed leopard lizard and burrow surveys of swales prior to inundation in swales. Those portions of swales that have been inundated annually for extended periods prior to Project approval will not be surveyed because potential burrows likely have been inundated and eroded, and blunt-nosed leopard lizard are unlikely to aestivate in these areas. Pre-wetting blunt-nosed leopard lizard surveys will be consistent with the *blunt-nosed leopard lizard Pre-Construction Survey Parameters* listed above under I.A.. The information from these surveys will be used to determine which habitat is most likely occupied and to identify appropriate swale use areas. If no blunt-nosed leopard lizard are found during the surveys, water may be applied throughout that following year. If a blunt-nosed leopard lizard is sighted within the low point of a swale (i.e., the expected inundation area) it will be difficult to determine whether the burrows in the area are being used for nesting or refugia. Therefore, MID will delay using the swale for banking until the active season (April 28 to July 1); then MID will apply water to the swale slowly (i.e., approximately 12 inches per minute) to ensure lizards can escape burrows.

Environmental Commitment Bio-5c: Implement other protective measures for blunt-nosed leopard lizard
MID will create at least three canal crossings along Gravelly Ford Canal and 6 canal crossings along the Section 8 Canal Northern Extension; the width of the crossings will vary from approximately 16 feet along Gravelly Ford Canal to approximately 8 feet along the Section 8 Canal Northern Extension. While making Gravelly Ford Canal improvements and installing the Section 8 Canal Northern Extension, MID would excavate slightly below the bottom grade of the canal to install a culvert and provide for a crossing. The area would be backfilled, covering the crossing with soil from the canal improvement. A similar concept could be employed for the Section 8 Canal Northern Extension, though the length of the pipe segment would be 4-8 feet and because of the flat hydraulic grade one larger pipe may be used.

Environmental Commitment BIO-8: Preconstruction Surveys for San Joaquin Kit Fox
Because of historical records and suitable San Joaquin kit fox habitat on or in the vicinity of Madera Ranch, it is assumed that kit foxes could be present at Madera Ranch. To avoid potential mortality of kit fox, agency approved (by the Service and CDFG) experienced biologists will survey to locate any natal dens, non-natal active dens, and/or potential dens in the Proposed Action area.

Visual surveys will be conducted during meandering transects of the 1,000 foot corridor. Preconstruction/preactivity surveys shall be conducted no less than 14 days and no more than 30 days prior to the beginning of ground disturbance and/or construction activities or any project activity likely to impact the San Joaquin kit fox. Kit foxes change dens four or five times during the summer months, and change natal dens one or two times per month (Morrell 1972). Surveys should identify kit fox habitat features on the project site and evaluate use by kit fox and, if possible, assess the potential impacts to the kit fox by the proposed activity. The status of all dens should be determined and mapped (see Survey Protocol). Written results of preconstruction/preactivity surveys must be received by the Service within five days after survey completion and prior to the start of ground disturbance and/or construction activities.

If a natal/pupping den is discovered within the project area or within 200-feet of the project boundary, the Service shall be immediately notified and under no circumstances should the den be disturbed or destroyed without prior authorization. If an active natal/pupping den is discovered within the project area or within 200-feet of the project boundary, the Service shall be immediately notified and under no circumstances should the den be disturbed or destroyed without prior authorization. If the preconstruction/preactivity survey reveals an active natal pupping or new information, MID should contact the Service and CDFG immediately. If an active natal den is found, the Service and CDFG will be notified and MID will delay construction within 1,000 feet of the den until the pups have been weaned or moved by the parents to an off-site den, and reroute or reschedule the construction to avoid impacts on the kit foxes.

Surveying will include meandering transect surveys for active dens (non-natal) out to 250 feet from the proposed facilities, which will involve simultaneous surveys for potential den sites out to 100 feet. If an active den is found, it will be avoided until the foxes have vacated the den. All potential dens will be flagged. Any potential den immediately in the construction corridor may need additional monitoring. Because construction is expected to proceed quickly—approximately 1,000 feet per day with trenches being open one to two nights—potential dens will not be collapsed. All surveys will be conducted within 30 days of site-specific construction by a qualified biologist.

To prevent inadvertent entrapment of kit foxes or other animals during the construction phase of a project, all excavated, steep-walled holes or trenches more than 2-feet deep should be covered at the close of each working day by plywood or similar materials. If the trenches cannot be closed, one or more escape ramps constructed of earthen-fill or wooden planks shall be installed. Before such holes or trenches are filled, they should be thoroughly inspected for trapped animals. If at any time a trapped or injured kit fox is discovered, the Service and CDFG shall be contacted. Kit foxes are attracted to den-like structures such as pipes and may enter stored pipes and become trapped or injured. All construction pipes, culverts, or similar structures with a diameter of 4-inches or greater that are stored at a construction site for one or more overnight periods should be thoroughly inspected for kit foxes before the pipe is subsequently buried, capped, or otherwise used or moved in any way. If a kit fox is discovered inside a pipe; that section of pipe should not be moved until the Service and CDFG have been consulted. If necessary, and under the direct supervision of the biologist, the pipe may be moved only once to remove it from the path of construction activity, until the fox has escaped.

Environmental Commitment BIO 9: Conduct Pre-Activity Surveys for Fresno Kangaroo Rat
The objective of the Fresno kangaroo rat surveys is to determine whether the Fresno kangaroo rat is present on the portion of Madera Ranch that could be affected by use of the swales for water banking and construction of water delivery canals. Initial trapping focused on the swales and canals east of Gravelly Ford Canal and species was not found. Subsequent trapping will occur 1-year before use of swales or construction of facilities west of Gravelly Ford Canal. Surveys in swales will be conducted 1 to 2 years before the first wetting of the swale and not surveyed again for 5 years after the wetting of the swale. If the swale is re-wetted within the 5-year period, it will not be surveyed for another 5-year period. No additional survey efforts will be conducted of any swale areas that have been surveyed twice with neither survey resulting in a single trapping of the Fresno kangaroo rat.

Kangaroo rat trapping efforts will be conducted by a surveyor holding a recovery permit for the Fresno kangaroo rat (10[a][1][A] permit). Meandering visual transect surveys for kangaroo rat burrow complexes and sign (e.g., tail drags, sand baths, seed caches) will be conducted by two to four biologists over all habitat within and out to 250 feet from the edge of the WSEP footprint, including swales, and within 100 feet of the top of Gravelly Ford Canal. All burrow complexes found will be recorded on a GPS unit, and data on the number of burrows, level of activity, and general suitability for kangaroo rats will be recorded in field notes (burrows suitable for kit fox also will be noted on GPS as part of this effort); information on vegetation type and percent cover also will be recorded.

Following completion of the survey, potential trapping sites will be prioritized based on a combination of the level of kangaroo rat activity (as evidenced by burrow density and/or the presence of other sign, though some areas without obvious sign may also be trapped) and project area coverage. Live trap stations and trap lines then will be established (staked and recorded with a GPS unit) by permitted biologists at the highest priority sites. Traps (Sherman live traps [Model XLKR: 13 inches x 3.5 inches x 3 inches]) will be set near active burrows, dust baths, or tracks, particularly along evident runways. Ten or more traps (or a number determined by the surveyor) will be set in relatively tight clusters (5-foot trap spacing) at high activity areas. Traps also will be set at 10 to 15 meter intervals (two traps per station) along evident movement corridors.

Traps will be baited with a mixture of millet seed, crimped oats, wild birdseed, or other suitable seed. Bedding (crumpled unbleached paper towel) will be placed at the inside end of each trap and will not be allowed to contact the tripping mechanism. Paper towels will be replaced each time an animal is captured in the trap. Traps will be opened and baited at sunset and checked 1-2 times/evening as deemed appropriate by the lead biologist. All traps will be closed after they have been checked at dawn. Trapping will be conducted at each trap site for five consecutive nights. Trapping will not be conducted during the week of a full moon, unless the sky is overcast and moonlight is substantially reduced. Trapping will not be conducted in December or January or in periods of cold or inclement weather detrimental to kangaroo rats and as stipulated in the surveyor's recovery permit. Although Fresno kangaroo rats are active year round, their populations generally are lowest at this time.

All non-Fresno kangaroo rats captured will be marked with a nontoxic semi-permanent ink marker on the belly to identify the re-trapping of the same animal(s). Trapping will cease with the capture of a Fresno kangaroo rat and MID, the Service, and CDFG will be notified as soon as possible, if not the same day, then the next workday, or no later than the Monday following the capture should it occur on a Friday or Saturday night. Any measurements obtained to provide evidence that the animal captured is a Fresno kangaroo rat will be achieved with minimal and delicate handling; fur and tissue samples will be taken only by a qualified, permitted biologist in accordance with their permit terms. A photo of the animal's hind legs (showing toes and including a ruler) will be taken and the animal will be immediately released; the animal's eyes will be shielded from the flash.

The lead biologist will notify MID of the proposed trapping schedule and will inform MID weekly which trapping areas have been completed. Any capture of Fresno kangaroo rat will be reported immediately to MID, the Service, CDFG, and Reclamation.

Environmental Commitment BIO-10: Conduct Preconstruction Surveys for Sensitive Species along the Off-Ranch Portion of Gravelly Ford Canal
Proposed off-ranch work areas associated with Gravelly Ford Canal improvements will be evaluated by a Service-approved biologist to determine whether habitat suitable to support sensitive species is present. If suitable habitat is discovered, MID will evaluate work locations to determine which species could be present and whether additional surveys may be needed. Depending on the results of this survey, MID also may implement Environmental Commitment BIO-1: Establish a Grasslands Conservation Easement, Environmental Commitment BIO-5: Pre-Activity Surveys for Blunt-Nosed Leopard Lizard.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action." For the proposed action, the Service considers the action area to be the area subject to the physical effects of construction, operation, and maintenance of the water delivery infrastructure, and water use. The action area is comprised of the recharge areas and recovery well network on Madera Ranch, the delivery canals and lift station network east of the ranch, Gravelly Ford Canal, the water delivery service area of MID, potential water delivery to the Gravelly Ford Water District and the Chowchilla Water District, and to municipal and industrial participants in Madera County and the possible delivery of water for environmental use outside Madera County at the Mendota Pool Wildlife Area. Although recovered water would be delivered to farmers in the MID, and potentially the Gravelly Ford Water District and the Chowchilla Water District, and municipal and industrial participants in Madera County, the effects to listed species in those areas are not part of the action area, because banked CVP water could only be delivered to these areas for existing authorized uses, unless further environmental analysis is conducted, including compliance with the National Environmental Policy Act and Endangered Species Act. The effects of delivering CVP water to these areas was consulted on in the January 19, 2001

Biological Opinion on the Long Term Contract Renewal of Friant Division and Cross Valley Unit Contracts (File Number 1-1-01-F-0027).

The water recharge and banking area for the proposed action are located at Madera Ranch in southwestern Madera County, California. The ranch encompasses 13,646 acres south of the Fresno River and north of the San Joaquin River. Most of the proposed water delivery canals lie east of the ranch. The City of Madera is approximately five miles northeast of Madera Ranch, and the City of Fresno is about 10 miles southeast.

Analytical Framework for the Jeopardy and Adverse Modification Analyses

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this biological opinion relies on four components: (1) *Status of the Species,* which evaluates the species' range-wide conditions, the factors responsible for those conditions, and their survival and recovery needs; (2) the *Environmental Baseline,* which evaluates the condition of the species in the action area, the factors responsible for those conditions and the role of the action area in the species' survival and recovery; (3) the *Effects of the Action,* which determines the direct and indirect impacts of the proposed federal action and the effects of any interrelated or interdependent activities on the species; and (4) *Cumulative Effects,* which evaluates the effects of future, non-federal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determinations are made by evaluating the effects of the proposed federal action in the context of the species' current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of these species in the wild. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR § 402.02. Instead, we have relied upon the statute and the August 6, 2004, Ninth Circuit Court of Appeals decision in *Gifford Pinchot Task Force v. U.S. Fish and Wildlife Service* (No. 03-35279) to complete the following analysis with respect to critical habitat.

The jeopardy analysis in this biological opinion places an emphasis on consideration of the range-wide survival and recovery needs of the species and the role of the action area in survival and recovery of the species as the context for evaluating the significance of the effects of the proposed federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Status of the Species

Fresno Kangaroo Rat
Listing -
The Fresno kangaroo rat (*Dipodomys nitratoides exilis*) was listed as endangered by the Service on January 30, 1985 (Service 1985). Critical habitat for the Fresno kangaroo rat was designated on 30, 1985 (Service 1985) and is composed of 857 acres in Fresno County. Twenty-three acres are in a small part of the Mendota Wildlife Area, 732 acres comprise the contiguous Alkali Sink

Ecological Reserve, both State-owned and managed, and 102 acres are in five privately-owned parcels.

Description –
The Fresno kangaroo rat is a heteromyid rodent and one of three subspecies of San Joaquin kangaroo rats, distinguished by being smaller than the Tipton (*D. n. nitratoides*) and the short-nosed kangaroo rat (*D. n. brevinasus*). It has a head and body length of 211 to 267 mm (8.25 to 10.5 inches) and a tail length of 120 to 162 mm (4.75 to 6.25 inches). San Joaquin kangaroo rats can be distinguished from other kangaroo rats within their range by the presence of four toes on the hind foot; other species have five toes.

Historical and Current Range –
Fresno and Tipton kangaroo rats once occupied contiguous geographic ranges in the Tulare Basin and the southeastern half of the San Joaquin Basin in the San Joaquin Valley (Service 1998). The Fresno kangaroo rats distribution at the time of listing was restricted to less than 6,500 acres in fragmented, isolated habitat in Fresno County. There are now no known populations within the historical geographic range in Merced, Madera, and Fresno Counties (Brylski and Roest 1994; Service 1998). The last verified capture was a single male, caught twice at the Alkali Sink Ecological Reserve in 1992. Since that time, no Fresno kangaroo rats have been found despite scent dog surveys and extensive trapping on critical habitat at the Alkali Sink Ecological Reserve, as recently as late fall 2004. The possibility exists that it may still survive in lands that have not been surveyed or that have been only minimally surveyed (privately owned parcels).

Essential Habitat Components –
Fresno kangaroo rats occupy sandy and saline sandy soils in chenopod scrub and annual grassland communities on the Valley floor. Most recently they have been found only in alkali sink communities between 200 to 300 feet elevation. Topography of their habitat is generally level, consisting of bare alkaline clay-based soils subject to seasonal inundation, but often broken by slightly rising mounds of more crumbly soils, that accumulate around shrubs or grasses. Associated plant species include seepweed, iodine bush, saltbushes, peppergrass, filaree, wild oats, and mouse-tail fescue (Culbertson 1946; Hoffmann 1974; Hoffman and Chesemore 1982). Within the alkali-sink plant associations, Fresno kangaroo rats probably were the most numerous small mammals under natural conditions, based on observations of the *D. nitratoides* population in an alkali sink community in the South Grasslands area of Merced County (Service 1998).

Foraging Ecology –
Fresno kangaroo rats collect and carry seeds in fur-lined cheek pouches. Seeds are a staple in their diet, but they also eat some types of green, herbaceous vegetation, and insects. Known foods include seeds of annual and perennial grasses, particularly wild oats, brome grasses (red and ripgut (*B. diundius*) brome, soft chess (*B. hordeaceus*), wild barley (*Hordeum* spp. mousetail fescue, alkali sacaton and saltgrass; and seeds of annual forbs such as filaree, peppergrass, common spikeweed (*Hemizonia pungens*), and shepherd's purse (*Capsella bursapastoris*) (Culbertson 1946; Koos 1979). Seeds of the woody and semiwoody shrubs, iodine bush and seepweed, *Suaeda moquinii*), also are eaten (Koos 1979). Seeds of woody shrubs, especially saltbushes diligently sought out by Tipton and short-nosed kangaroo rats, are also probably

important for Fresno kangaroo rats (D.F. Williams unpubl. observ., cited in Service 1998). Insects make up a small part of their diet, varying from about two to 10 percent frequency in fecal samples (Koos 1979).

In fall and winter, after the wet season commences, sprouts of seeds and tender new growth of grasses and forbs may be essential items in the diet of Fresno kangaroo rats. Green developing seed heads may be important in the spring months. Seeds, and perhaps insects, are the most important items in the diet in late spring, summer, and fall.

Most kangaroo rats gather seeds when they are available and cache them for consumption later. Typically, caches are made in small pits that hold the contents of the two cheek pouches. Caches can be located on the surface of the soil, and are typically scattered over the home range of the individual (called scatterhoards [Vander Wall 1990]). Alternatively, caches can be placed within an animal's burrow. This type of cache is called a larderhoard (Vander Wall 1990). Larderhoards are larger than scatterhoards, although larderhoards are often made up of several smaller caches, each of which also only hold the contents of about two cheek pouches. A few small seed caches were found in excavated burrows of Fresno kangaroo rats (Culbertson 1946).

Culbertson (1946) speculated that Fresno kangaroo rats do not cache seeds in their burrows to the same extent as other kangaroo rats because the soil where they live is damp much of the year. Stored seeds spoil rapidly under such conditions. He also speculated that Fresno kangaroo rats would therefore be obligated to forage on the surface year round to a greater extent than kangaroo rats that cached seeds in drier areas. These may be reasonable assumptions, but Culbertson's observations were based on a very limited sample size, and he did not check for scatterhoards, only larderhoards. However, smaller heteromyid rodents have a greater tendency to larderhoard seeds than to scatterhoard them, possibly as a protection again interspecific cache pilferage (Price and Mittler 2006; Leaver and Daly 2001; Price et al. 2000). The Fresno kangaroo rat is the smallest of all kangaroo rats, and so would be expected to mainly larderhoard seeds when caching them.

Reproductive Ecology –
Nothing is known about mating behavior or the mating system of Fresno kangaroo rats in the wild. Culbertson (1946) recorded observations of captive Fresno kangaroo rats, including young born in captivity, and Eisenberg (1963) and Eisenberg and Issac (1963) described mating behavior and care of young in a captive colony of short-nosed kangaroo rats. Mating probably takes place on the surface within the territory of the female.

Sexual maturity is attained in as little as 82 days after birth. Pregnant female Fresno kangaroo rats have been taken between February and March and June and September (Hoffmann 1974). Pregnancies between June and September might represent second or third litters for adult females, summer breeding by young females born in the spring, or both. Females are probably capable of breeding two or more times per year.

Breeding probably is initiated in winter after onset of the rainy season. Nothing is known about pair bonds in wild populations, but there probably are no lasting male-female pair bonds formed. Females may breed with more than one male during a breeding cycle, though typically a single male attains dominance for mating purposes with one or more females within his territory, as is true of closely related kangaroo rat species. Most females born the previous season probably do not give birth until mid-February or early March during years with average or below average rainfall. In captivity, gestation was 32 days and young were weaned at 21 to 24 days; average litter size in captive Fresno kangaroo rats was about two (range, one to three) (Culbertson 1946; Eisenberg and Issac 1963).

Young are born in the burrow, probably within a nest of dried, shredded vegetation. Culbertson (1946) did not locate nests in excavated burrow systems and wrote that captive pregnant females usually did not make nests before giving birth. However, he thought that this was because these females were greatly disturbed by capture and confinement shortly before giving birth. Young remain continuously in the burrow until they are fully furred and able to move about easily. Cutbertson (1946) believed that young Fresno kangaroo rats were not found out of the burrow and foraging for themselves until about six weeks old. This is consistent with estimates for Tipton and shortnosed kangaroo rats (D.F. Williams, unpubl. data, cited in Service 1998).

Based on limited information, populations of Fresno kangaroo rats probably turn over annually with most individuals born in the spring or summer not surviving to breed the following spring (Hoffmann 1974; Williams et al. 1993; D.F. Williams unpubl. data, cited in Service). This pattern is typical for kangaroo rats in general. In the only study of Fresno kangaroo rats, Hoffmann (1974) found that only two of 75 marked animals were present on study plots through four trapping periods between 10 February and 28 December. Numbers were lowest in April, prior to dispersal of spring-born young, and peaked in May. By June, juveniles comprised the majority of the population. Maximum longevity in natural populations is probably between three to five years, based on studies of short-nosed kangaroo rats (Williams et al. 1993).

Reproductive potential of Fresno kangaroo rats is relatively low compared to most rodents. Limiting factors on populations are unknown, but availability of suitable sites for burrows, free from winter flooding, probably is a major factor. No specific information is available on limitations of food. In a study of the Dulzura kangaroo rat (*D. simulans*), Moore (2003) did not find any individual or population-level responses to seed supplementation, other than changes in distribution between supplemented and non-supplemented plots. Although Moore's study only used two sites, her work supports the idea that kangaroo rats are not food-limited, per se. However, other forms of food besides seeds may be important. One study on Ord's kangaroo rat (*D. ordii*) suggests that green herbaceous vegetation, which contains 6-MBOA, may stimulate reproduction (Rowsemitt and O'Connor 1989).

Movements and Habitat Use –
Home range size varies by habitat features, season, and sex. Warner (1976) found home ranges to be small (approx. 677 square yards) at the Alkali Sink Ecological Reserve. Warner's data may underestimate the typical home range size based on reports of other kangaroo rats. For example, in the closely related Merriam's kangaroo rat (*D. merriami*), size of home range averaged about 4.06 acres for males and 3.9 acres for females in a study in New Mexico (Blair 1943). Hoffmann (1974) estimated population densities of Fresno kangaroo rats to range from between 6.8 to 10.1 individuals per six acres during February through December. Other studies estimated densities from 0.8 to 11.9 Fresno kangaroo rats per acre at different sites and in different seasons (Warner 1976; Koos 1977, 1979).

Fresno kangaroo rats shelter in ground burrows that are dug by them or their predecessors. Burrows usually are found in relatively light, crumbly soils in raised areas. The surface area covered by the burrow system of individual Fresno kangaroo rats generally varies from about seven to 12 feet on a side. There are usually two to five burrow entrances that slant gently underground, and one or more holes that open from a vertical shaft. Tunnels are about two inches in diameter and extend about 12 to 15 inches below ground. There may be several interconnecting tunnels and numerous dead-end side branches. Nesting material or large food caches have not been found in the few burrows that have been excavated (Culbertson 1946).

The burrow system is the apparent focus of territoriality in Fresno kangaroo rats. Except for young associated with females, each burrow system is typically occupied by a single individual. Culbertson (1946) found that captive Fresno kangaroo rats always fought when placed together in a small cage, and concluded that individuals were intolerant of each other. Yet when given sufficient space, individuals in a captive breeding colony of short-nosed kangaroo rats were more tolerant of others than expected from the typical behaviors of other species (Eisenberg 1963; Eisenberg and Isaac 1963). The social relations of Fresno kangaroo rats in the wild are unknown.

Fresno kangaroo rats are nocturnal and active year round. As with all other kangaroo rats, they do not hibernate and cannot recover unaided from hypothermia. Tappe (1941) reported seeing Tipton kangaroo rats emerge from their burrows and begin above-ground activities as early as seven minutes before sunset in early spring. Other kangaroo rats in the San Joaquin Valley are sometimes seen above ground by day in March and April (D.F. Williams unpubl. obser, cited in Service 1998), but this is considered not to be typical Fresno kangaroo rat activity. In one study, the peak period of capture of Fresno kangaroo rats occurred later after dark than that of the larger, more aggressive Heermann's kangaroo rats (Hoffman 1985).

Sandbathing is an important behavior for all kangaroo rats (Eisenberg 1963). Kangaroo rats have a dermal gland that secretes oil onto the pelage and when kangaroo rats are unable to sandbathe, they may develop sores on their bodies and their fur becomes matted from oily secretions.

Predators and Interspecific Competition –
There is no information on the role of predation in the population dynamics of Fresno kangaroo rats. Kangaroo rats are especially sensitive to low-frequency sounds, which may explain the function of the inflated auditory bullae. This sensitivity to such sounds is thought to be important in detecting approaching predators (Webster and Webster 1971), such as snakes and owls. Work on the desert kangaroo rat and other dune vertebrates have shown that off-road vehicle sound levels have a serious impact on hearing acuity (Brattstrom and Bondello 1983 cited in Goldingay et al. 1997). In some kangaroo rat species, footdrumming is an important behavior. However, in smaller species, such as the San Joaquin kangaroo rat, footdrumming is poorly developed, or non-existent, and is not expected to play a role in intra- or inter-specific competition (Randall 2001 and references therein).

Hoffmann (1974) believed that competition with Heermann's kangaroo rat (*D. heermanni*), a larger, more widely distributed species that uses a broader range of plant communities, might be an important factor in elimination of Fresno kangaroo rats from sites impacted heavily by grazing.

Reasons for Decline and Threats to Survival –
The conversion of native habitat to accommodate agricultural uses, urbanization, and transportation infrastructure is the leading cause of the decline in Fresno kangaroo rat populations (Service 1998). So much alkali scrub and arid grassland habitat has been lost and otherwise subject to detrimental anthropogenic effects that the Fresno kangaroo already was believed to be extinct by the early 1930s, until its rediscovery by Culbertson (1934). An estimated 14,629 acres of habitat remain for this species. Moderate livestock grazing may benefit habitat conditions by reducing the density of nonnative plants (Brylski and Roest 1994), but intensive livestock grazing makes most of the 14,629 acres marginal habitat (Service 1998). The continued conversion, degradation, and fragmentation of suitable habitat are major threats to the persistence of this species, as are floods, rodenticides, predation by native and nonnative species, and interspecific competition (Service 1998). As previously noted, interspecific competition with Heermann's kangaroo rat (*D. heermani*), a larger, more widely distributed species that uses a broader range of plant communities, may threaten the species under current conditions (Hoffmann 1974).

Status with Respect to Recovery –
The Recovery Plan for Upland Species of the San Joaquin Valley (Service 1998) includes the Fresno kangaroo rat. The recovery plan identifies the need to protect natural land between the Alkali Sink Ecological Reserve and the San Joaquin River to the north (Sandy Mush Road/South Grasslands Area). The plan recognizes that the largest block of natural land within the species' range is in western Madera County. The Service completed a five-year review in February 2010 (Service 2007a) and no change in status was recommended.

<u>San Joaquin Kit Fox</u>

Listing -
The San Joaquin kit fox was listed as an endangered species on March 11, 1967 (Service 1967) and was listed by the State of California as a threatened species on June 27, 1971. This is the umbrella species for the Recovery Plan for Upland Species of the San Joaquin Valley, California (Service 1998).

Description –
The kit fox is the smallest canid species in North America and the San Joaquin kit fox is the largest subspecies in skeletal measurements, body size, and weight. Adult males average 80.5 centimeters (31.7 inches) in total length, and adult females average 76.9 centimeters (30.3 inches in total length (Grinnell et al. 1937). Kit foxes have long slender legs and are approximately 30 centimeters (12 inches) high at the shoulder. The average weight of adult males is 2.3 kilograms (five pounds), and the average of adult females is 2.1 kilograms (4.6 pounds) (Morrell 1972).

General physical characteristics of kit foxes include a small, slim body, relatively large ears set close together, narrow nose, and a long, bushy tail tapering slightly toward the tip. The tail is typically carried low and straight.

Color and texture of the fur coat of kit foxes varies geographically and seasonally. The most commonly described colorations are buff, tan, grizzled, or yellowish-gray dorsal coats (McGrew 1979). Two distinctive coats develop each year: a tan summer coat and a silver-gray winter coat (Morrell 1972). The ear pinna (external ear flap) is dark on the back side, with a thick border of white hairs on the forward-inner edge and inner base. The tail is distinctly black-tipped.

Historical and Current Range –
In the San Joaquin Valley before 1930, the range of the San Joaquin kit fox extended from southern Kern County north to Tracy, San Joaquin County, on the west side, and near La Grange, Stanislaus County, on the east side (Grinnell et al. 1937; Service 1998). Historically, this species occurred in several San Joaquin Valley native plant communities. In the southernmost portion of the range, these communities included Valley Sink Scrub, Valley Saltbush Scrub, Upper Sonoran Subshrub Scrub, and Annual Grassland.

Kit foxes currently inhabit some areas of suitable habitat on the San Joaquin Valley floor and in the surrounding foothills of the coastal ranges, Sierra Nevada, and Tehachapi Mountains, from southern Kern County north to Contra Costa, Alameda, and San Joaquin Counties on the west, and near La Grange, Stanislaus County on the east side of the Valley, and some of the larger scattered islands of natural land on the Valley floor in Kern, Tulare, Kings, Fresno, Madera, and Merced Counties.

The largest extant populations of kit foxes are in western Kern County on and around the Elk Hills and Buena Vista Valley, Kern County, and in the Carrizo Plain Natural Area, San Luis Obispo County. Though monitoring has not been continuous in the central and northern portions of the range, populations were recorded in the late 1980s at San Luis Reservoir, Merced County (Briden et al. 1987); North Grasslands and Kesterson National Wildlife Refuge (NWR) area on the Valley floor, Merced County (Paveglio and Clifton 1988); and in the Los Vaqueros watershed, Contra Costa County in the early 1990s (Service 1998). Smaller populations are also known from other parts of the San Joaquin Valley floor, including Madera County and eastern Stanislaus County (Williams 1990). An additional population of kit foxes has been identified in close proximity to the action area (Service 1998). This "Panoche Core Population" is generally located on lands west of I-5 in the Panoche Valley and suitable lands to the north and south, such as the Silver Creek Ranch and lands from Little Panoche Creek up to Route 152. Kit foxes occur at varying densities in the areas between the core populations (e.g., Kettleman Hills), providing linkages between core populations, and also probably with smaller, more isolated populations in adjacent valleys and in the Kreynhagen Hills and Anticline Ridge around Coalinga and Avenal. Maintain and enhance connecting corridors for movement of kit foxes between the Kettleman Hills and the Valley's edge through the farmed gap between the Kettleman and Guijarral Hills, and between the Guijarral Hills and Anticline Ridge; and around the western edge of the Pleasant Valley and Coalinga.

Essential Habitat Components –
Kit foxes prefer loose-textured soils (Grinnell et al 1937; Hall 1946; Egoscue 1962; Morrell 1972), but are found on virtually every soil type. Dens appear to be scarce in areas with shallow soils because of the proximity to bedrock (O'Farrell and Gilbertson 1979; O'Farrell et al 1980), high water tables (McCue et al. 1981), or impenetrable hardpan layers (Morrell 1972). However,

kit foxes will occupy soils with a high clay content, such as in the Altamont Pass area in Alameda County, where they modify burrows dug by other animals (Orloff et al 1986). Sites that may not provide suitable denning habitat may be suitable for feeding or providing cover.

[Note: The following sections discussing land values for kit fox were prepared for Reclamation by Brian Cypher in the report ***Kit Fox Conservation in the San Luis Drainage Unit Study: Ecological Considerations Relevant to the Development of a Conservation Strategy for Kit Foxes*** (Cypher 2006).]

Natural Land Values.
Kit foxes are an aridland-adapted species. They occur in arid regions, typically deserts, throughout North America (Cypher 2003). Accordingly, in the San Joaquin Valley, optimal habitats for San Joaquin kit foxes generally are those in which conditions are more desert-like. These include arid shrublands and grasslands (Service 1998). These areas are characterized by sparse or no shrub cover, sparse ground cover with patches of bare ground, short vegetative structure (herbaceous vegetation < 18 inches tall), and sandy to sandy-loam soils.

Tall and/or dense vegetation generally is less optimal for foxes (Smith et al. 2005). Such conditions make it difficult for foxes to detect approaching predators or capture prey. Kit foxes also tend to avoid rugged, steep terrain. Predation risk apparently is higher for foxes under such topographic conditions (Warrick and Cypher 1998). In general, flat terrain or slopes under 5 percent are optimal, slopes of 5-15 percent are suitable, and slopes greater than 15 percent are unsuitable. For this reason, the foothills of the Coast Ranges generally are considered to demark the western boundary for suitable kit fox habitat. Finally, kit foxes appear to be strongly linked ecologically to kangaroo rats. Kit foxes are especially well adapted for preying on kangaroo rats, and consequently, kit fox abundance and population stability are highest in areas where kangaroo rats are abundant (Service 1998; Cypher 2003). Kangaroo rats also are aridland-adapted species, and thus, reach their greatest densities in the San Joaquin Valley in arid habitats.

Following are assessments of relative value for various natural habitats present in the San Joaquin Valley:

Saltbush scrub. This is an aridland habitat generally dominated by saltbush shrubs (*Atriplex* spp.), and with ground cover dominated by non-native Brome grasses (*Bromus* spp.). Kangaroo rats are abundant. This habitat is optimal for kit foxes, and kit foxes generally achieve their highest densities in areas with this habitat type (e.g., Lokern Natural Area, Buena Vista Valley, Carrizo Plain, Elkhorn Plain). Although this habitat is favorable for foxes, it should be noted that dense patches of shrubs provide cover for kit fox predators and may be avoided by foxes.

Arid grasslands. This is an aridland habitat with few or no shrubs, and which is dominated by non-native grasses, particularly red brome (*Bromus madritensis rubens*). Vegetation structure is low and patches of bare ground are common. Kangaroo rats are abundant. This habitat is optimal for kit foxes. Grazing can further reduce the vegetative structure rendering this habitat even more suitable.

Alkali sink. This habitat occurs in lower regions closer to the Valley center, and thus is subject to soil saturation and seasonal flooding in the winter and spring. It usually is dominated by iodine bush (*Allenrolfea* spp.) or sinkweed (*Suaeda* spp.) shrubs with a patchy, low-structure ground cover. Kangaroo rats can be abundant. This habitat can be suitable for kit foxes, particularly if slightly higher topography is available for dens.

Mesic grasslands. This habitat type is more common in the eastern and northern portions of the Valley where precipitation is more abundant. This type tends to have few or no shrubs and is dominated by non-native wild oat grasses (*Avena* spp.). Vegetation structure may be higher than 18 inches and dense, particularly in years with above-average precipitation, and this could result in increased predation risk for kit foxes. Bare ground may be sparse. The rodent community tends to be dominated by California ground squirrels instead of kangaroo rats. This habitat can be suitable for kit foxes, particularly if it is moderately-to-heavily grazed.

<u>Agricultural Land Values</u>.
Agricultural lands inherently present challenges for kit foxes. Ground disturbance is frequent (e.g., tilling, maintenance, harvesting), which can destroy dens. Also, most agricultural lands in the Valley are irrigated, which can flood and collapse dens. Agricultural lands also are subject to intensive chemical applications, including fertilizers, pesticides, and defoliants. Use of rodenticides is common in some agricultural environments and is particularly problematic for kit foxes due to the potential for secondary poisoning. Finally, all of the factors above in addition to the relative sterility of most agricultural fields (e.g., weed suppression) result in a lack of prey availability for kit foxes.

Another detrimental attribute of agricultural lands is the presence of coyotes and non-native red foxes. Coyotes are the primary cause of mortality for kit foxes in most areas (Cypher et al. 2003). The threat to kit foxes from red foxes is still being evaluated, but the potential for both interference and exploitative competition is high (Cypher et al. 2001). These highly adaptable species are able to persist in agricultural lands. They are not dependent on dens for cover, they are highly mobile which facilitates avoiding dangers and locating food, and they are highly omnivorous. Also, kit foxes are more vulnerable to predation in agricultural areas due to the relative scarcity of den sites, as described previously. Thus, agricultural lands are generally not suitable for long-term occupation by kit foxes, although lands adjacent to natural habitats may be used for occasional foraging (Warrick et al. 2007).

Most available information on the value of agricultural lands to kit foxes is qualitative in nature, but one quantitative investigation has been conducted (Warrick et al. 2007). Following are assessments of relative value for several types of agricultural lands found near the project area:

Annual crops (e.g., cotton, tomatoes, alfalfa, carrots): Lands with these crops usually have low to no prey (except possibly alfalfa), and are subject to frequent disturbance, irrigation, and chemical application. Kit foxes do not appear able to permanently occupy these lands, and use primarily appears limited to occasional foraging when these lands are adjacent to natural habitats.

Orchards (e.g., fruit trees, nut trees) and Vineyards. Lands with these crops are not always "sanitized" of all herbaceous vegetation, and therefore sometimes may support some prey (primarily ground squirrels, deer mice, and house mice). Also, the open understory of orchards facilitates predator detection by kit foxes. Kit foxes have been observed to forage in orchards as well as to occasionally spend a day or so resting, usually in man-made structures (e.g., pipes, rubble piles). Orchards are probably relatively permeable for kit foxes, although the risk of an unsuccessful crossing most likely increases with distance. Vineyards probably are permeable to kit foxes, but as with orchards, the risk of an unsuccessful crossing most likely increases with distance. Also, the rodent-proof fences erected around some vineyards would severely inhibit entry by kit foxes.

Fallow land values. Some agricultural lands may be fallowed for a season, a year, or multiple years. The value of these lands for kit foxes is highly dependent upon the duration of fallowing and the location of the lands. Lands that are fallowed for only a season likely have little value to foxes. Generally, a season is not sufficient time for a prey base to reestablish. Also, renewed ground disturbance and irrigation at the end of the season likely would result in the destruction of any fox dens created during the fallow period. Lands that are fallowed for one or more years could have greater value to kit foxes. This period might be sufficient for the reestablishment of some prey and the creation of dens. Lands fallowed for multiple years could even potentially be used by kit foxes to produce and raise young. Kit foxes likely would be forced from these lands when they were returned to agricultural production. Kit foxes would be at risk of injury or death during the reinitiation of agricultural activities if they failed to vacate the property in a timely manner. Foxes that did vacate also would be at greater risk if they were forced into unfamiliar areas.

Fallow lands immediately adjacent to natural lands might be used relatively quickly by kit foxes. In Kern County near Bakersfield, foxes have been observed to use agricultural lands within weeks of being fallowed with use increasing as these lands remained fallowed (B. Cypher, pers. obs.). As the distance between fallow lands and occupied habitat increases, the potential for use by kit foxes decreases. As described above, kit foxes face risks when crossing agricultural lands, and this risk may preclude colonization or use of fallow lands that are not adjacent to occupied habitat.

Foraging Ecology –
The diet of the San Joaquin kit fox varies geographically, seasonally, and annually, based on temporal and spatial variation in abundance of potential prey. In the southern portion of their range, kangaroo rats, pocket mice, white-footed mice (*Peromyscus* spp.), and other nocturnal rodents comprise about one-third or more of their diets, Kit foxes are also known to prey on California ground squirrel, black-tailed hares, San Joaquin antelope squirrels, desert cottontails, ground nesting birds, and insects (Scrivner et al. 1987a). Known prey species of the kit fox include white-footed mice (*Peromyscus* spp.), insects, California ground squirrels, kangaroo rats (*Dipodomys* spp.), San Joaquin antelope squirrels, black-tailed hares (*Lepus californicus*), and chukar (*Alectoris chukar*) (Jensen 1972;Archon 1992), listed in approximate proportion of occurrence in fecal samples. Kit foxes also prey on desert cottontails (*Sylvilagus audubonii*), ground-nesting birds, and pocket mice (*Perognathus* spp.).

The diets and habitats selected by coyotes and kit foxes living in the same areas are often quite similar. Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts, which are quite common in semi-arid, central California. Competition for resources between coyotes and kit foxes may result in kit fox mortalities. Coyote-related injuries accounted for 50 to 87 percent of the mortalities of radio collared kit foxes at Camp Roberts, the Carrizo Plain Natural Area, the Lokern Natural Area, and the Naval Petroleum Reserves (Cypher and Scrivner 1992; Standley et al. 1992).

Reproductive Ecology –
Adult San Joaquin kit foxes are usually solitary during late summer and fall. In September and October, adult females begin to excavate and enlarge natal dens (Morrell 1972). Typically, pups are born between February and late March following a gestation period of 49 to 55 days (Egoscue 1962; Morrell 1972). Mean litter sizes reported for San Joaquin kit foxes range from 2.0 (White and Ralls 1993) to 3.8 at the Naval Petroleum Reserve (Spencer et al. 1992; Spiegel and Tom 1996; Cypher et al. 2000). Pups appear above ground at about age three to four weeks, and are weaned at age six to eight weeks.

The proportion of females bearing young, of adult San Joaquin kit foxes vary annually with environmental conditions, particularly food availability. Annual rates range from zero to 100 percent, and reported mean rates include 61 percent at the Naval Petroleum Reserve (Cypher et al. 2000), 64 percent in the Lokern area (Spiegel and Tom 1996), and 32 percent at Camp Roberts (Spencer et al. 1992). Although some yearling female kit foxes will produce young, most do not reproduce until age two years (Spencer et al. 1992; Spiegel and Tom 1996; Cypher et al. 2000). Some young of both sexes, but particularly females may delay dispersal, and may assist their parents in the rearing of the following year's litter of pups (Spiegel and Tom 1996). The young kit foxes begin to forage for themselves at about four to five months of age (Koopman et al. 2000; Morell 1972).

Mean annual survival rates reported for adult San Joaquin kit foxes range from 0.44 to 0.60 (Cypher et al. 2000; Standley et al. 1992; Spiegel and Disney 1996; Ralls and White 1995). However, survival rates vary widely among years (Spiegel and Disney 1996; Cypher et al. 2000). Mean survival rates for juvenile San Joaquin kit foxes (< one year old) are lower than rates for adults. Survival to age one year ranged from 0.14 to 0.2 1 (Cypher et al. 2000; Standley et al. 1992; Ralls and White 1995). For both adults and juveniles, survival rates of males and females are similar. San Joaquin kit foxes may live to ten years in captivity (McGrew 1979) and 8 years in the wild (Berry et al. 1987).

Estimates of fox density vary greatly throughout its range, and have been reported as high as 1.2 animals per square kilometer in optimal habitats in good years (Service 1998). At the Elk Hills in Kern County, density estimates varied from 0.7 animals per square kilometer in the early 1980s to 0.01 animals per square kilometer in 1991 (Service 1998). Kit fox home ranges vary in size from approximately 2.6 square kilometers to 3 1.2 square kilometers (Spiegel and Tom 1996; Service 1998). Knapp (1979) estimated that a home range in agricultural areas is approximately 2.5 square kilometers. Individual home ranges overlap considerably, at least outside the core activity areas (Morrell 1972; Spiegel 1996).

Movements and Habitat Use –
Although most young kit foxes disperse less than eight kilometers (Scrivner et al. 1987b), dispersal distances of up to 122 kilometers have been documented for the San Joaquin kit fox (Scrivner et al. 1993; Service 1998). Dispersal can be through disturbed habitats, including agricultural fields, and across highways and aqueducts. The age at dispersal ranges from four to

32 months (Cypher 2000). Among juvenile kit foxes surviving to July 1 at the Naval Petroleum Reserve, 49 percent of the males dispersed from natal home ranges while 24 percent of the females dispersed (Koopman et al. 2000). Among dispersing kit foxes, 87 percent did so during their first year of age. Some kit foxes delay dispersal and may inherit their natal home range.

San Joaquin kit foxes are primarily nocturnal, although individuals are occasionally observed resting or playing (mostly pups) near their dens during the day (Grinnell et al. 1937). A mated pair of kit foxes and their current litter of pups usually occupy each home range. Other adults, usually offspring from previous litters, also may be present (Koopman et al. 2000), but individuals often move independently within their home range (Cypher 2000). Average distances traveled each night range from 9.3 to 14.6 kilometers and are greatest during the breeding season (Cypher 2000).

Kit foxes maintain core home range areas that are exclusive to mated pairs and their offspring (White and Ralls 1993; Spiegel 1996; White and Garrott 1997). This territorial spacing behavior eventually limits the number of foxes that can inhabit an area owing to shortages of available space and per capita prey. Hence, as habitat is fragmented or destroyed, the carrying capacity of an area is reduced and a larger proportion of the population is forced to disperse. Increased dispersal generally leads to lower survival rates and, in turn, decreased abundance because greater than 65 percent of dispersing juvenile foxes die within 10 days of leaving their natal range (Koopman et al. 2000).

The San Joaquin kit fox seems to prefer more gentle terrain and decreases in abundance as terrain ruggedness increases (Grinnell et al. 1937; Morrell 1972; Warrick and Cypher 1998). The kit fox is often associated with open grasslands, which form large contiguous blocks within the eastern portions of the range of the animal. San Joaquin kit foxes also exhibit a capacity to utilize habitats that have been altered by humans. San Joaquin kit foxes can utilize some types of agriculture (e.g. orchards and alfalfa), although the long-term suitability of these habitats is unknown (Jensen 1972; Service 1998). Orchards sometimes support prey species if the grounds are not manicured; however, denning potential is typically low and kit foxes can be more susceptible to predation by coyotes within the orchards (Orloff 2002). Alfalfa fields provide an easily accessible prey base (Woodbridge 1998; Young 1989), and berms adjacent to alfalfa fields sometimes provide good denning habitat (Orloff 2002).

Kit foxes use some types of agricultural land where uncultivated land is maintained, allowing for denning sites and a suitable prey base (Knapp 1978; Hansen 1988; Warrick et al. 2007). In the Lost Hills area, radio collared kit foxes predominantly used natural habitat remaining in the California Aqueduct right-of-way (Warrick et al. 2007), even though this habitat had lower availability relative to other habitats. Orchards were the second most frequently used habitats, followed by row crops and other habitats (residential, grassland, and fallow fields). Kit foxes were documented to travel a maximum distance of 1.5 kilometers into orchards and 1.1 kilometers into row crops (Warrick et al. 2007). No dens were observed in the agricultural areas. Kit foxes appear reluctant to cross these lands due to insufficient refugia from predators (Cypher et al. 2005). The lack of kit fox occupancy in farmland is in contrast to observations of the closely related swift fox in western Kansas (Jackson and Choate 2000; Matlack et al. 2000). Differences in habitat use between the species may be due to differences in farming practices

(Warrick et al. 2007). Farmland in the San Joaquin Valley is more heavily disturbed. The farmlands are irrigated, and fields are not left fallow for as long as a duration as the farmlands in Kansas. These practices in California likely result in a sparse prey base and unsuitable habitat for denning, discouraging the kit fox from occupying agricultural lands.

Dens are used by kit foxes for temperature regulation, shelter from adverse environmental conditions, and escape from predators. Kit foxes are reputed to be poor diggers, and their dens are usually located in areas with loose-textured, friable soils (Morrell 1972; O'Farrell 1984). However, the depth and complexity of their dens suggest that they possess good digging abilities, and kit fox dens have been observed on a variety of soil types (Service 1998). Some studies have suggested that where hardpan layers predominate, kit foxes create their dens by enlarging the burrows of California ground squirrels (*Spermophilus beecheyi*) or badgers (*Taxidea taxus*) (Jensen 1972; Morrell 1972; Orloff et al. 1986). In parts of their range, particularly in the foothills, kit foxes often use ground squirrel burrows for dens (Orloff et al. 1986). Kit fox dens are commonly located on flat terrain or on the lower slopes of hills. About 77 percent of all kit fox dens are at or below midslope (O'Farrell 1984), with the average slope at den sites ranging from 0 to 22 degrees (CDFG 1980; O'Farrell 1984; Orloff et al. 1986). Natal and pupping dens are generally found in flatter terrain. Common locations for dens include washes, drainages, and roadside berms. Kit foxes also commonly den in human-made structures such as culverts and pipes (O'Farrell 1984; Spiegel and Tom 1996).

Natal and pupping dens may include from two to 18 entrances and are usually larger than dens not used for reproduction (O'Farrell et al. 1980; O'Farrell and McCue 1981). Natal dens may be reused in subsequent years (Egoscue 1962). It has been speculated that natal dens are located in the same location as ancestral breeding sites (O'Farrell 1984). Active natal dens are generally 1.9 to 3.2 kilometers from the dens of other mated kit fox pairs (Egoscue 1962; O'Farrell and Gilbertson 1979). Natal and pupping dens usually can be identified by the presence of scat, prey remains, matted vegetation, and mounds of excavated soil (i.e., ramps) outside the dens (O'Farrell 1984). However, some active dens in areas outside the valley floor often do not show evidence of use (Orloff et al. 1986) During telemetry studies of kit foxes in the northern portion of their range, 70 percent of the dens that were known to be active showed no sign of use (e.g., tracks, scats, ramps, or prey remains) (Orloff et al. 1986). In another more recent study in the Coast Range, 79 percent of active kit fox dens lacked evidence of recent use other than signs of recent excavation (Jones and Stokes Associates 1989).

A kit fox can use more than 100 dens throughout its home range, although on average, an animal will use approximately 12 dens a year for shelter and escape cover (Cypher et al. 2001). Kit foxes typically use individual dens for only brief periods, often for only one day before moving to another den (Ralls et al. 1990). Possible reasons for changing dens include infestation by ectoparasites, local depletion of prey, or avoidance of coyotes. Kit foxes tend to use dens that are located in the same general area, and clusters of dens can be surrounded by hundreds of hectares of similar habitat devoid of other dens (Egoscue 1962). In the southern San Joaquin Valley, kit foxes were found to use up to 39 dens within a denning range of 129 to 195 hectares (Morrell 1972). An average den density of one den per 28 to 37 hectares was reported by O'Farrell (1984) in the southern San Joaquin Valley.

Reasons for Decline and Threats to Survival –
The distribution and abundance of the kit fox have decreased since its listing in 1967. This trend is reasonably certain to continue into the foreseeable future unless measures to protect, sustain, and restore suitable habitats, and alleviate other threats to their survival and recovery, are implemented. Threats that are seriously affecting kit foxes are described in further detail in the following paragraphs.

Less than 20 percent of the habitat within the historical range of the kit fox remained when the subspecies was listed as endangered in 1967, and there has been a substantial net loss of habitat since that time. Historically, San Joaquin kit foxes occurred throughout California's Central Valley and adjacent foothills. Extensive land conversions in the Central Valley began as early as the mid-1800s with the Arkansas Reclamation Act. By the 1930s, the range of the kit fox had been reduced to the southern and western parts of the San Joaquin Valley (Grinnell et al. 1937). The primary factor contributing to this restricted distribution was the conversion of native habitat to irrigated cropland, industrial uses (e.g., hydrocarbon extraction), and urbanization (Laughrin 1970; Jensen 1972; Morrell 1972; 1975). Approximately one-half of the natural communities in the San Joaquin Valley were tilled or developed by 1958 (Service 1980).

This rate of loss accelerated following the completion of the CVP and the State Water Project, which diverted and imported new water supplies for irrigated agriculture (Service 1995). Approximately 7,972 square kilometers of habitat, or about 267 square kilometers per year, were converted in the San Joaquin region between 1950 and 1980 (CDFG 1988). The counties specifically noted as having the highest wildland conversion rates included Kern, Tulare, Kings and Fresno, all of which are occupied by kit foxes. From 1959 to 1969 alone, an estimated 34 percent of natural lands were lost within the then-known kit fox range (Laughrin 1970).

The majority of the documented loss of essential habitat has been the result of conversion to irrigated agriculture. By 1979, only approximately 1,497 square kilometers out of a total of approximately 34,400 square kilometers on the San Joaquin Valley floor remained as undeveloped land (Williams 1985; Service 1980a). During 1990 to 1996, a gross total of approximately 71,500 acres of habitat were converted to farmland in 30 counties (total area 23.1 million acres) within the Conservation Program Focus area of the CVP. This total includes 42,520 acres of grazing land and 28,854 acres of "other" land, which was predominantly comprised of native habitat. During the same time period, approximately 101,700 acres were converted to urban land use within the Conservation Program Focus area (California Department of Conservation [CDC] 1994, 1996, 1998). Because these assessments included a substantial portion of the Central Valley and adjacent foothills, they provide the best scientific and commercial information currently available regarding the patterns and trends of land conversion within the kit fox's geographic range.

In summary, more than one million acres of suitable habitat for kit foxes have been converted to agricultural, municipal, or industrial uses since the listing of the kit fox in 1967. In contrast, less than 500,000 acres have been preserved or are subject to community-level conservation efforts designed, at least in part, to further the conservation of the kit fox (Service 1998).

Land conversions contribute to declines in kit fox abundance through direct and indirect mortalities, displacement, reduction of prey populations and denning sites, changes in the distribution and abundance of larger canids that compete with kit foxes for resources, and reductions in carrying capacity. Kit foxes may be buried in their dens during land conversion activities (C. Van Horn Job, pers. comm. 2000), or permanently displaced from areas where structures are erected or the land is intensively irrigated (Jensen 1972; Morrell 1975).

Dens are essential for the survival and reproduction of kit foxes that use them year-round for shelter and escape, and in the spring for rearing young. Kit foxes generally have dozens of dens scattered throughout their territories. However, land conversion reduces the number of typical earthen dens available to kit foxes. Denning opportunities on land converted to agriculture are limited due to agricultural practices, such as cultivation, irrigation, chemical treatments, and other disturbances. The loss of denning habitat can impede successful migration of kit fox across agricultural lands because of greater vulnerability to predation resulting from a lack of possible escapes.

Kit foxes use some types of agricultural land where uncultivated land is maintained, allowing for denning sites and a suitable prey base (Jensen 1972; Knapp 1979; Hansen 1988). Kit foxes also den on small parcels of native habitat surrounded by intensively maintained agricultural lands (Knapp 1979), and adjacent to dryland farms (Jensen 1972; Kato 1986; Orloff et al. 1986).

Extensive habitat destruction and fragmentation have contributed to smaller, more isolated populations of kit foxes. Small populations have a higher probability of extinction than large populations because their low abundance renders them susceptible to stochastic (i.e., random) events such as high variability in age and sex ratios, and catastrophes such as floods, droughts, or disease epidemics (Lande 1988; Frankham and Ralls 1998; Saccheri et al. 1998). Similarly, isolated populations are more susceptible to extirpation by accidental or natural catastrophes because the likelihood of recolonization has been diminished. These chance events can adversely affect small, isolated populations with devastating results. Extirpation can even occur when the members of a small population are healthy, because whether the population increases or decreases in size is less dependent on the age-specific probabilities of survival and reproduction than on chance (sampling probabilities). Owing to the probabilistic nature of extinction, many small populations will eventually go extinct when faced with these stochastic risks (Caughley and Gunn 1996).

Vehicles appear to be the primary cause of mortality for urban kit foxes, and most strikes occur on arterial roads, which have higher traffic volumes and speed limits (Bjurlin et al. 2005; Cypher et al. 2005). Two-lane roads may not be as dangerous for kit foxes as are major arterial roads (Cypher et al. 2005). Kit foxes are more frequently struck near intersections between major roads and other linear rights-of-way (e.g., railroads, canals, other roads), which most likely function as movement corridors for kit foxes, and the foxes do not appear to avoid roads for denning sites (Bjurlin et al. 2005).

Several species prey upon San Joaquin kit foxes. Predators (such as coyotes, bobcats, non-native red foxes, badgers (*Taxidea taxus*), and golden eagles (*Aquila chrysaetos*)) will kill kit foxes. Badgers, coyotes, and red foxes also may compete for den sites (Service 1998). The diets and habitats selected by coyotes and kit foxes living in the same areas are often quite similar (Cypher and Spencer 1998). Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts (which are quite common in semi-arid, central California). Land conversions and associated human activities have led to changes in the distribution and abundance of coyotes, which compete with kit foxes for resources.

Coyotes occur in most areas with abundant populations of kit foxes and, during the past few decades, coyote abundance has increased in many areas owing to a decrease in ranching operations, favorable landscape changes, and reduced control efforts (Orloff et al. 1986; Cypher and Scrivner 1992; White and Ralls 1993; White et al. 1995). Although coyotes are common in both natural and agricultural landscapes, they pose a greater predation threat to the kit fox on agricultural lands because of the decreased availability or absence of escape dens and vegetative cover (Cypher et al. 2005). Coyotes may kill kit foxes in an attempt to reduce resource competition. Coyote-related injuries accounted for 50 to 87 percent of the mortalities of radio collared kit foxes at Camp Roberts, the Carrizo Plain Natural Area, the Lokern Natural Area, and the Naval Petroleum Reserves (Cypher and Scrivner 1992; Standley et al. 1992; Ralls and White 1995; Spiegel 1996).

Coyote-related deaths of adult foxes appear to be largely additive (i.e., in addition to deaths caused by other mortality factors such as disease and starvation) rather than compensatory (i.e., tending to replace deaths due to other mortality factors; White and Garrott 1997). The survival rates of adult foxes decrease significantly as the proportion of mortalities caused by coyotes increase (Cypher and Spencer 1998; White and Garrott 1997), and increases in coyote abundance may contribute to significant declines in kit fox abundance (Cypher and Scrivner 1992; Ralls and White 1995; White et al. 1996). There is some evidence that the proportion of juvenile foxes killed by coyotes increases as fox density increases (White and Garrott 1999). This density-dependent relationship would provide a feedback mechanism that reduces the amplitude of kit fox population dynamics and keeps foxes at lower densities than they might otherwise attain. In other words, coyote-related mortalities may prevent fox population growth, and may instead prolong population declines.

Land-use changes have also contributed to the expansion of nonnative red foxes into areas inhabited by kit foxes. Historically, the geographic range of the red fox did not overlap with that of the San Joaquin kit fox. By the 1970s, however, introduced and escaped red foxes had established breeding populations in many areas inhabited by San Joaquin kit foxes (Lewis et al. 1993). Red foxes are rarely observed in natural settings, and are much more abundant on agricultural lands, They appear to be dependent on the presence of water (Cypher et al. 2001), a resource readily available on irrigated farmlands, while kit foxes do not drink free water (Golightly and Ohmart 1983). The larger and more aggressive red foxes are known to kill kit foxes (Ralls and White 1995), and could displace them, as has been observed in the arctic when red foxes expanded into the ranges of smaller arctic foxes (Hersteinsson and Macdonald 1982). The increased abundance and distribution of nonnative red foxes is perhaps a greater threat to kit foxes than coyotes because red foxes and kit foxes have not evolved in the presence of each other, are closer morphologically and taxonomically, and would likely have higher dietary overlap, potentially resulting in more intense competition for resources.

Wildlife diseases do not appear to be a primary mortality factor that consistently limits kit fox populations throughout their range (McCue and O'Farrell 1988; Standley and McCue 1992). However, central California has a high incidence of wildlife rabies cases (Schultz and Bairett 1991), and high seroprevalences of canine distemper virus and canine parvovirus indicate that kit fox populations have been exposed to these diseases (McCue and O'Farrell 1988; Standley and McCue 1992). Hence, disease outbreaks could potentially cause substantial mortality or contribute to reduced fertility in seropositive females, as was noted in closely-related swift foxes (*Vulpes velox*).

For example, there are some indications that rabies virus may have contributed to a catastrophic decrease in kit fox abundance at Camp Roberts, San Luis Obispo County, California, during the early 1990s. San Luis Obispo County had the highest incidence of wildlife rabies cases in California during 1989 to 1991, and striped skunks (*Mephitis mephitis*) were the primary vector (Barrett 1990; Schultz and Barrett 1991; Reilly and Mangiamele 1992). A rabid skunk was trapped at Camp Roberts during 1989 and two foxes were found dead due to rabies in 1990 (Standley et al. 1992). Captures of kit foxes during annual live trapping sessions at Camp Roberts decreased from 103 to 20 individuals during 1988 to 1991. Captures of kit foxes were positively correlated with captures of skunks during 1988 to 1997, suggesting that some factor(s) such as rabies virus was contributing to concurrent decreases in the abundances of these species. Also, captures of kit foxes at Camp Roberts were negatively correlated with the proportion of skunks that were rabid when trapped by County Public Health Department personnel two years previously. These data suggest that a rabies outbreak may have occurred in the skunk population and spread into the fox population. A similar time lag in disease transmission and subsequent population reductions was observed in Ontario, Canada, although in this instance the transmission was from red foxes to striped skunks (Macdonald and Voigt 1985).

Some methods of pest and rodent control pose a threat to kit foxes through direct or secondary poisoning, and these threats are often encountered in agricultural settings. Kit foxes may be killed if they ingest rodenticide in a bait application, or if they eat a rodent that has consumed the bait. Even sublethal doses of rodenticides may lead to the death of these animals by impairing their ability to escape predators or find food. Pesticides and rodenticides may also indirectly affect the survival of kit foxes by reducing the abundances of their staple prey species. For example, the California ground squirrel, which is the staple prey of kit foxes in the northern portion of their range and on agricultural lands, was thought to have been eliminated from Contra Costa County in 1975, after extensive rodent eradication programs. Field observations indicated that the long-term use of ground squirrel poisons in this county severely reduced kit fox abundance through secondary poisoning and the suppression of populations of its staple prey (Orloff et al. 1986).

Historically, kit foxes may have existed in a metapopulation structure of core and satellite populations, some of which periodically experienced local extinctions and recolonization (Service 1998). Today's populations exist in an environment drastically different from the historic one, however, and extensive habitat fragmentation will result in geographic isolation, smaller population sizes, and reduced genetic exchange among populations, thereby increasing the vulnerability of kit fox populations to extirpation. Populations of kit foxes are extremely susceptible to the risks associated with small population size and isolation because they are characterized by marked instability in population density. For example, the relative abundance of kit foxes at the Naval Petroleum Reserves, California, decreased ten-fold during 1981 to 1983, increased seven-fold during 1991 to 1994, and then decreased two-fold during 1995 (Cypher and Scrivner 1992; Cypher and Spencer 1998).

Many populations of kit fox are at risk of chance extinction owing to small population size and isolation. This risk has been prominently illustrated during recent, drastic declines in the populations of kit foxes at Camp Roberts and Fort Hunter Liggett. Captures of kit foxes during annual live trapping sessions at Camp Roberts decreased from 103 to 20 individuals during 1988 to 1991. This decrease continued through 1997 when only three kit foxes were captured (White et al. 2000). A similar decrease in kit fox abundance occurred at nearby Fort Hunter Liggett, and only two kit foxes have been observed on this installation since 1995 (L. Clark, pers. comm.; February 15, 2000). It is unlikely that the current numbers of kit foxes at Camp Roberts and Fort Hunter Liggett will increase substantially in the near future because there is limited potential for recruitment. The chance of substantial immigration is low because the nearest core population on the Carrizo Plain is distant (greater than 16 miles) and separated from these installations by barriers to kit fox movement such as roads, developments, and irrigated agricultural areas. Also, there is a relatively high abundance of sympatric predators and competitors on these installations that contribute to low survival rates for kit foxes and, as a result, may limit population growth (White et al. 2000). These populations may therefore be on the verge of extinction.

The destruction and fragmentation of habitat could also eventually lead to reduced genetic variation in populations of kit foxes that are small and geographically isolated. Genetic assessments indicate that historic gene flow among populations was quite high, and that gene flow between populations is still occurring (Schwartz et al. 2005). Kit fox dispersal likely still maintains genetic variation throughout the range of the kit fox. Disruption of kit fox dispersal abilities through habitat loss, however, could result in an increase in inbreeding and a loss of genetic variation. These factors could increase the extinction risk for small, isolated populations of kit foxes by interacting with demography to reduce fecundity, juvenile survival, and lifespan (Lande 1988; Frankham and Ralls 1998; Saccheri et al. 1998).

The impacts of genetic isolation may already be apparent in the Camp Roberts and Panoche populations. Genetic data revealed low allelic diversity at these locations. The population in the Camp Roberts region may have been historically small, as evidenced by the lack of historical occurrences. Relatively low allelic diversity could be the result of a few individuals recolonizing the Camp Roberts area (founder event), and a subsequent low number of migrants contributing to genetic diversity. The Panoche population is located in a small, relatively isolated valley, and also appears to be experiencing a low number of migrants into the population (Schwartz et al. 2005).

Arid systems are characterized by unpredictable fluctuations in precipitation, which lead to high frequency, high amplitude fluctuations in the abundance of mammalian prey for kit foxes (Goldingay et al. 1997; White and Garrott 1999). Because the reproductive and neonatal survival rates of kit foxes are strongly depressed at low prey densities (White and Ralls 1993; White and Garrott 1997, 1999), periods of prey scarcity owing to drought or excessive rain events can contribute to population crashes and marked instability in the abundance and distribution of kit foxes (White and Garrott 1999). Frequent, rapid decreases in kit fox density can increase the extinction risk for small, isolated populations.

Status with Respect to Recovery –
A recovery plan approved in 1983 proposed interim objectives of halting the decline of the San Joaquin kit fox and increasing population sizes above 1981 levels (Service 1983). Conservation efforts subsequent to the 1983 recovery plan have included habitat acquisition by U.S. Bureau of Land Management, California Department of Fish and Game, California Energy Commission, Bureau of Reclamation, the Service, and The Nature Conservancy. Purchases most significant to conservation efforts were the acquisitions in the Carrizo Plain, Ciervo-Panoche Natural Area, and the Lokern Natural Area. Other lands have been acquired as mitigation for land conversions, both temporary and permanent.

A recovery plan covering upland species of the San Joaquin Valley, including the kit fox, was written in 1998. The primary goal of the recovery strategy for kit foxes identified in the Recovery Plan is to establish a complex of interconnected core and satellite populations throughout the species' range. The long-term viability of each of these core and satellite populations depends partly upon periodic dispersal and genetic flow between them. Therefore, kit fox movement corridors between these populations must be preserved and maintained. In the northern range, from the Ciervo Panoche in Fresno County northward, kit fox populations are small and isolated, and have exhibited significant decline. The core populations are the Ciervo Panoche area, the Carrizo Plain area, and the western Kern County population. Satellite populations are found in the urban Bakersfield area, Porterville/Lake Success area, Creighton Ranch, Pixley Wildlife Refuge, Allensworth Ecological Reserve, Semitropic/Kern NWR, Antelope Plain, eastern Kern grasslands, Pleasant Valley, western Madera County, Santa Nella, Kesterson NWR, and Contra Costa County. Major corridors connecting these population areas are on the east and west side of the San Joaquin Valley, around the bottom of the Valley, and cross-valley corridors in Kern, Fresno, and Merced Counties.

The 1998 recovery plan includes strategies for habitat protection that will maintain population interchange between areas adjacent to the action area. Connecting corridors for movement of kit foxes around the western edge of the Pleasant Valley and Coalinga in Fresno County should be maintained and enhanced. Existing natural lands in the Mendota area should be expanded and connected with the Ciervo-Panoche area, through restoration of habitat on retired, drainage-problem farmland. Natural lands that would provide a connection are scarce, because the land between these two populations is dominated by agriculture. Although kit fox will move up to 1.5 kilometers into farmland, they appear reluctant to cross large expanses of agricultural land due to the lack of escapes from predators (Cypher et al. 2005). Six occurrences of kit fox in the lands connecting these populations were recorded in 1920; there have been no subsequent recorded observations in the agricultural lands connecting Ciervo-Panoche and the Mendota area. Retired agricultural lands may provide important stepping stones to maintain connectivity throughout the action area.

Blunt-nosed Leopard Lizard

Listing –
The blunt-nosed leopard lizard (*Gambelia sila*) was listed as Endangered by the Service on March 11, 1967 (Service 1967). Critical habitat has not been proposed.

Description –
The blunt-nosed leopard lizard (*Gambelia sila*) was originally described and named from a specimen collected from Fresno County in 1890. This is a relatively large lizard of the family Iguanidae (Stebbins 1985). Adult males are typically 3.4 to 4.7 inches from snout to vent and weigh between 31.8 and 37.4 grams. The adult females are similar in length (range 3.4 to 4.4 inches), but weigh only 20.6 to 29.3 grams (Tollestrup 1982; Uptain et al. 1985 *in* Service 1998).

Historical and Current Range –
The blunt-nosed leopard lizard is endemic to the San Joaquin Valley (Montanucci 1970; Tollestrup 1979 *in* Service 1998) and is thought to have once occurred from the Tehachapi Mountains in Kern County northward to Stanislaus County (Service 1998). The current range is thought to include scattered populations throughout the undeveloped land of the San Joaquin Valley and in the foothills of the Coast Range below 2,600 feet (Montanucci 1970; Service 1998).

Essential Habitat Components –
The blunt-nosed leopard lizard inhabits open, sparsely vegetated areas within nonnative grassland, valley sink scrub, valley needlegrass grassland and alkali playa communities on the floor of the San Joaquin Valley (Holland 1986). The species also inhabits the saltbush scrub communities within the foothills of the southern San Joaquin Valley and the adjacent Carrizo Plain. These classifications by Holland (1986) are subsumed within the more general alkali desert scrub and annual grassland habitat types described by Mayer and Laudenslayer (1988).

Blunt-nosed leopard lizards are typically absent where habitat conditions include steep slopes, dense vegetation, or areas subject to seasonal flooding (Montanucci 1965). Preferred substrates range from sandy or gravelly soils to hardpan. It prefers flat terrain and tends to avoid dense or tall herbaceous cover that restricts vision for foraging and escape from predators (Warrick et al 1998).

Foraging Ecology –
The diet of the blunt-nosed lizard consists primarily of insects and other lizards (Service 1998). Insects consumed include grasshoppers and crickets in the Order Orthoptera and moths of the Lepidoptera. Other lizards consumed by blunt-nosed lizards include: side-blotched lizards (*Uta stansburiana*), coast horned lizards (*Phrynosoma coronatum*), California whiptails (*Cnemidophorus tigris*), and the spiny lizards (*Sceloporus* spp.) (Service 1998). Interspecific competition is hypothesized to occur between blunt-nosed lizards and California whiptails because they consume similar food items (Montanucci 1965; Service 1998).

Reproductive Ecology –
Breeding begins within a month of emergence from dormancy and typically lasts from the end of April through the beginning of June, but occasionally may last through the end of June. Adults are paired and frequently occupy the same burrow during the breeding period and for up to

several months afterwards (Montanucci 1965; Service 1998). Two to six eggs are laid in June or July in a chamber excavated for a nest or in an existing burrow system. Adverse conditions can delay or halt reproduction, while variable environmental conditions may result in more than one clutch of eggs being produced per year (Service 1998).

Movements and Habitat Use –
These lizards frequently seek refuge in small mammal burrows (Stebbins 2003), using small rodent burrows for shelter from predators and temperature extremes. Burrows are usually abandoned ground squirrel tunnels or kangaroo rat burrows (abandoned or occupied). In areas of low mammal burrow density, lizards will construct shallow, simple tunnels in earth berms or under rocks. Burrows are important structures that enable blunt-nosed lizards to moderate temperature extremes and avoid a wide-range of predators. Species preying upon blunt-nosed lizards include: snakes, shrikes, hawks, owls, eagles, squirrels, skunks, badgers, coyotes, and foxes (Montanucci 1965; Tollestrup 1979). Blunt-nosed leopard lizards can have large home range sizes. Germano (pers. comm. 2009) found that typical home range sizes range from four to eight hectares, with a few females having home ranges as large as 40 hectares (almost 100 acres).

Above ground activity of blunt-nosed lizards is primarily dependent on temperature with optimal activity occurring when air temperatures are between 74 and 104 degrees Fahrenheit (°F) and ground temperatures are between 72 and 97 °F. Smaller lizards and young have a wider activity range than adults and as a result they emerge from hibernation earlier than adults, remain active later in the year, and begin their activity earlier during the day (Montanucci 1965). These temperature-related patterns result in adult lizards being active above ground from March or April through June or July. By the end of June or July, the majority of sightings are of sub-adult and hatchling lizards (Service 1998).

Reasons for Decline and Threats to Survival –
Populations of the blunt-nosed leopard lizard declined to levels warranting listing because of the conversion and degradation of suitable habitat (Service 1998). Agricultural, urban, petroleum, mineral, and other development activities altered an estimated 94 percent of the wildlands on the Valley floor by 1985. The conversion of land for agricultural purposes along the Friant-Kern Canal has led to a loss of patches of suitable habitat large enough likely to be inhabited by blunt-nosed leopard lizard. Ground disturbance, including that associated with agricultural practices, may kill or harm individuals. Due to its obligate use of burrows, the blunt-nosed leopard lizard can be adversely impacted by rodent control programs (through loss of burrows over time). Also, there is some concern that the application of broad-spectrum insecticides on natural lands that harbor blunt-nosed leopard lizards-to combat agricultural pest species-may be an additional threat to their survival. It also is threatened by overgrazing and rodent control. Those lands where the species still exists are often heavily grazed or treated with pesticides, both of which have been shown to have detrimental effects on the lizard (Germano and Williams 1992).

Status with Respect to Recovery –
A recovery plan for the blunt-nosed leopard lizard was approved in 1980, and most recently, the species is included in the Recovery Plan for Upland Species of the San Joaquin Valley (Service 1998). A five-year review was completed in February 2010, and no change in status was

recommended (Service 2010a). The recovery plans for the blunt-nosed leopard lizard identified habitat units that are considered essential for the continued persistence of viable populations within the San Joaquin Valley but, having no legal status equivalent to critical habitat; the conversion of suitable habitat within these units has continued (Service 1980a). Consequently, habitat disturbance, conversion, and fragmentation continue to be the greatest threats to blunt-nosed leopard lizard populations. Other direct and indirect effects result from automobile and off-highway vehicle traffic, livestock grazing, and pesticides (Service 1998). The recovery strategy for this species includes identifying and protecting existing habitat, determining the best habitat management practices, and conducting public information and education programs (Service 1998).

<u>*California Tiger Salamander Central California Distinct Population Segment*</u>

Listing –
The California tiger salamander was federally listed as threatened throughout its range on August 4, 2004 (Service 2004a). Detailed information about the tiger salamander can be found in this document. Critical habitat was proposed for the Central population of the California tiger salamander on August 10, 2004 (Service 2004b) and finalized on August 23, 2005 (Service 2005a).

Description –
The California tiger salamander is a large, stocky, terrestrial salamander with a broad, rounded snout. Adults may reach a total length of 8.2 inches (Petranka 1998; Stebbins 2003). California tiger salamanders exhibit sexual dimorphism; males tend to be larger than females. The coloration of the California tiger salamander is white or yellowish markings against black. As adults, California tiger salamanders tend to have the creamy yellow to white spotting on the sides with much less on the dorsal surface of the animal, whereas other tiger salamander species have brighter yellow spotting that is heaviest on the top of the animals.

Historical and Current Range –
Historically, the California tiger salamander inhabited low elevation grassland and oak savanna plant communities of the Central Valley, and adjacent foothills, and the inner Coast Ranges in California (Jennings and Hayes 1994; Storer 1925; Shaffer et al. 1993). The species occurs from near sea level up to approximately 3,900 feet in the Coast Ranges and up to about 1,600 feet in the Sierra Nevada foothills (Shaffer et al. 2004). Along the Coast Ranges, the species occurred from the Santa Rosa area of Sonoma County south to the vicinity of Buellton in Santa Barbara County. In the Central Valley and surrounding foothills, the species occurred from northern Yolo County southward to northwestern Kern County and northern Tulare County.

The California tiger salamander's current range includes the Great Central Valley of California and adjacent foothill districts as well as the coastal grasslands from the vicinity of San Francisco Bay south at least to Santa Barbara County (Storer 1925; Morey 1988). This species ranges from the vicinity of Petaluma, Sonoma County and Dunnigan, Colusa-Yolo County line, with an isolated outpost north of the Sutter Buttes at Gray Lodge, Butte County in the Central Valley, south to vernal pools in northwest Tulare County, and in the Coast Range south to ponds and vernal pools between Buellton and Lompoc in the Santa Ynez drainage, Santa Barbara County

(Jennings and Hayes 1994). They are absent through most of western Fresno and Kings Counties. In the San Francisco Bay Area, they may be found from Alameda County south to San Benito County (Service 2003a). In the San Joaquin Valley, this species occurs in scattered locations south to Tulare County (Jennings and Hayes 1994). The known elevational range of this species extends from three to 1,054 meters.

There are three distinct population segments of California tiger salamander federally listed as threatened: the Sonoma County DPS, the Santa Barbara DPS and the central California DPS. The central California DPS is separated from the Sonoma County DPS by the Carquinez Straits of the San Francisco Bay, the Napa River, and the coastal mountains between Sonoma County and the Central Valley (Service 2003a).

Life History, Foraging, and Reproductive Ecology –
The California tiger salamander has an obligate biphasic life cycle (Shaffer et al. 2004). Although the larvae salamanders develop in the vernal pools and ponds in which they were born, they are otherwise terrestrial salamanders that spend most of their post-metamorphic lives in widely dispersed underground retreats (Shaffer et al. 2004; Trenham et al. 2001). Subadult and adult California tiger salamanders spend the dry summer and fall months of the year in the burrows of small mammals, such as California ground squirrels (*Spermophilus beecheyi*) and Botta's pocket gopher (*Thomomys bottae*) (Storer 1925; Loredo and Van Vuren 1996; Petranka 1998; Trenham 1998a). Camel crickets and other invertebrates within these burrows likely are prey for California tiger salamanders, as well as protection from the sun and wind associated with the dry California climate that can cause desiccation (drying out) of amphibian skin. Although California tiger salamanders are members of a family known as "burrowing salamanders," California tiger salamanders are not known to create their own burrows in the wild, perhaps due to the hardness of soils in the California ecosystems in which they are found. Because they live underground in the burrows of mammals, they are rarely encountered by humans even where they are abundant. The burrows may be active or inactive, but because they collapse within approximately 18 months if not maintained, an active population of burrowing mammals is necessary to sustain sufficient underground refugia for the species (Loredo et al. 1996). California tiger salamanders also may utilize leaf litter or desiccation cracks in the soil.

The upland burrows inhabited by California tiger salamanders have often been referred to as "estivation" sites, which implies a state of inactivity, however, recent studies show that the animals move, feed, and remain active in their burrows (Trenham 2001; Van Hattem 2004). Researchers have long inferred that they are feeding while underground because the animals arrive at breeding ponds in good condition and are heavier when entering a pond than when leaving. Thus, upland habitat is a more accurate description of the terrestrial areas used by California tiger salamanders.

Once fall or winter rains begin, the salamanders emerge from the upland sites on rainy nights to feed and to migrate to the breeding ponds (Stebbins 1985, 1989; Shaffer et al. 1993). Adult salamanders mate in the breeding ponds, after which the females lay their eggs in the water (Twitty 1941; Shaffer et al. 1993; Petranka 1998). Historically, the California tiger salamander utilized vernal pools, but the animals also currently breed in livestock stockponds. Females attach their eggs singly, or in rare circumstances, in groups of two to four, to twigs, grass stems, vegetation, or debris (Storer 1925; Twitty 1941). In ponds with no or limited vegetation, they may be attached to objects, such as rocks and boards on the bottom (Jennings and Hayes 1994). After breeding, adults leave the pool and return to the small mammal burrows (Loredo et al. 1996; Trenham 1998a), although they may continue to come out nightly for approximately the next two weeks to feed (Shaffer et al. 1993). In drought years, the seasonal pools may not fill and the adults cannot breed (Barry and Shaffer 1994).

Salamander eggs hatch in ten to 14 days with newly hatched larvae salamanders ranging from 0.45 to 0.56 inch in total length (Petranka 1998). The larvae are aquatic. They are yellowish gray in color and have broad fat heads, possess large, feathery external gills, and broad dorsal fins that extend well onto their back. The larvae feed on zooplankton, small crustaceans, and aquatic insects for about six weeks after hatching, after which they switch to larger prey (J. Anderson 1968). Larger larvae have been known to consume smaller tadpoles of Pacific treefrogs (*Hyla regilla*) and California red-legged frogs (*Rana dyaytonii*) (J. Anderson 1968; P. Anderson 1968). The larvae are among the top aquatic predators in the seasonal pool ecosystems. They often rest on the bottom in shallow water, but also may be found at different layers in the water column in deeper water. The young salamanders are wary and when approached by potential predators, will dart into vegetation on the bottom of the pool (Storer 1925).

The larval stage of the California tiger salamander usually last three to six months, as most seasonal ponds and pools dry up during the summer (Petranka 1998). Amphibian larvae must grow to a critical minimum body size before they can metamorphose (change into a different physical form) to the terrestrial stage (Wilbur and Collins 1973). Individuals collected near Stockton in the Central Valley during April varied from 1.88 to 2.32 inches in length (Storer 1925). Feaver (1971) found that larvae metamorphosed and left the breeding pools 60 to 94 days after the eggs had been laid, with larvae developing faster in smaller, more rapidly drying pools.

The longer the ponding duration, the larger the larvae and metamorphosed juveniles are able to grow, and the more likely they are to survive and reproduce (Pechmann et al. 1989; Semlitsch et al. 1988; Morey 1998; Trenham 1998b). The larvae will perish if a site dries before metamorphosis is complete (P. Anderson 1968; Feaver 1971). Pechmann et al. (1989) found a strong positive correlation with ponding duration and total number of metamorphosing juveniles in five salamander species.

In Madera County, Feaver (1971) found that only 11 of 30 pools sampled supported larval California tiger salamanders, and 5 of these dried before metamorphosis could occur. Therefore, out of the original 30 pools, only six (20 percent) provided suitable conditions for successful reproduction that year. Size at metamorphosis is positively correlated with stored body fat and survival of juvenile amphibians, and negatively correlated with age at first reproduction (Semlitsch et al. 1988; Scott 1994; Morey 1998).

In the late spring or early summer, before the ponds dry completely, metamorphosed juveniles leave them and enter upland habitat. This emigration occurs in both wet and dry conditions (Loredo and Van Vuren 1996; Loredo et al. 1996). Unlike during their winter migration, the wet conditions that California tiger salamanders prefer do not generally occur during the months when their breeding ponds begin to dry. As a result, juveniles may be forced to leave their ponds on rainless nights. Under these conditions, they may move only short distances to find temporary upland sites for the dry summer months, waiting until the next winter's rains to move further into suitable upland refugia. Once juvenile California tiger salamanders leave their birth ponds for upland refugia, they typically do not return to ponds to breed for an average of 4 to 5 years. However, they remain active in the uplands, coming to the surface during rainfall events to disperse or forage (Trenham et al. 2000).

Lifetime reproductive success for California and other tiger salamanders is low. Trenham et al. (2000) found the average female bred 1.4 times and produced 8.5 young that survived to metamorphosis per reproductive effort. This resulted in roughly 11 metamorphic offspring over the lifetime of a female. Two reasons for the low reproductive success are the preliminary data suggest that most individuals of the California tiger salamanders require two years to become sexually mature, but some individuals may be slower to mature (Shaffer et al. 1993); and some animals do not breed until they are four to six years old. While individuals may survive for more than ten years, many breed only once, and in some populations, less than 5 percent of marked juveniles survive to become breeding adults (Trenham 1998b). With such low recruitment, isolated populations are susceptible to unusual, randomly occurring natural events as well as from human caused factors that reduce breeding success and individual survival. Factors that repeatedly lower breeding success in isolated pools can quickly extirpate a population.

Dispersal and migration movements made by California tiger salamanders can be grouped into two main categories: (1) breeding migration; and (2) interpond dispersal. Breeding migration is the movement of salamanders to and from a pond from the surrounding upland habitat. After metamorphosis, juveniles move away from breeding ponds into the surrounding uplands, where they live continuously for several years. At a study in Monterey County, it was found that upon reaching sexual maturity, most individuals returned to their natal/ birth pond to breed, while 20 percent dispersed to other ponds (Trenham et al. 2001). Following breeding, adult California tiger salamanders return to upland habitats, where they may live for one or more years before breeding again (Trenham et al. 2000).

California tiger salamanders are known to travel large distances from breeding ponds into upland habitats. Maximum distances moved are generally difficult to establish for any species, but California tiger salamanders in Santa Barbara County have been recorded to disperse 1.3 miles from breeding ponds (Sweet 1998). California tiger salamanders are known to travel between breeding ponds; one study found that 20 to 25 percent of the individuals captured at one pond were recaptured later at ponds approximately 1,900 and 2,200 feet away (Trenham et al. 2001). In addition to traveling long distances during migration to or dispersal from ponds, California tiger salamanders may reside in burrows that are far from ponds. At one site in Contra Costa County, hundreds of California tiger salamanders have been captured three years in a row in upland habitat approximately 0.75 mile from the nearest breeding pond (Orloff 2003).

Although the observations above show that California tiger salamanders can travel far, typically they stay closer to breeding ponds. Evidence suggests that juvenile California tiger salamanders disperse further into upland habitats than adult California tiger salamanders. A trapping study conducted in Solano County during winter of 2002-2003 found that juveniles used upland habitats further from breeding ponds than adults (Trenham and Shaffer 2005). More juvenile salamanders were captured at distances of 328,656, and 1,312 feet from a breeding pond than at 164 feet. Large numbers, approximately 20 percent of total captures, were found 1,312 feet from a breeding pond. Fitting a distribution curve to the data revealed that 95 percent of juvenile salamanders could be found within 2,099 feet of the pond, with the remaining 5 percent being found at even greater distances. Preliminary results from the 2003-04 trapping efforts detected juvenile California tiger salamanders at even further distances, with a large proportion of the total salamanders caught at 2,297 feet from the breeding pond (Trenham personal communication 2004). Surprisingly, most juveniles captured, even those at 2,100 feet, were still moving away from ponds (Ben Fitzpatrick, pers. comm. 2004).

These data show that many California tiger salamanders travel far while still in the juvenile stage. Post-breeding movements away from breeding ponds by adults appear to be much smaller. During post-breeding emigration, radio-equipped adult California tiger salamanders were tracked to burrows 62 to 813 feet from their breeding ponds (Trenham 2001). These reduced movements may be due to adult California tiger salamanders having depleted physical reserves post-breeding, or also due to the drier weather conditions that can occur during the period when adults leave the ponds.

In addition, rather than staying in a single burrow, most individuals used several successive burrows at increasing distances from the pond. Although the studies discussed above provide an approximation of the distances that California tiger salamanders regularly move from their breeding ponds, upland habitat features will drive the details of movements in a particular landscape. Trenham (2001) found that radio-tracked adults favored grasslands with scattered large oaks, over more densely wooded areas. A drift-fence survey at a Santa Barbara County pond that is bordered by a strawberry field found that many emigrating juveniles moved towards the strawberry field; however, no adults were captured entering the pond from this direction. Most of the California tiger salamanders entered the pond from extensive, overgrazed grassy flats rather than sandhill or eucalyptus habitats in other quadrants (Steve Sykes, pers. comm. 2003). Based on radio-tracked adults, there is no indication that certain habitat types are favored as corridors for terrestrial movements (Trenham 2001). In addition, at two ponds completely encircled by drift fences and pitfall traps, captures of arriving adults and dispersing new metamorphs were distributed roughly evenly around the ponds. Thus, it appears that dispersal into the terrestrial habitat occurs randomly with respect to direction and habitat types.

Predators –
Several species prey have either been documented or likely prey upon the California tiger salamander including coyotes (*Canis latrans*), raccoons (*Procyon lotor*), opossums (*Didelphis virginiana*), egrets (*Egretta species*), great blue herons (*Ardea herodias*), crows (*Corvus brachyrhynchos*), ravens (*Corvus corax*), bullfrogs (*Rana catesbeiana*), mosquito fish (*Gambusia affinis*), and crayfish (*Procambarus* spp.). Domestic dogs (*Canis familiaris*) have been observed eating California tiger salamanders at Lake Lagunitas at Stanford University (Sean Barry, pers. comm. 2004).

Reasons for Decline and Threats to Survival –
A primary cause of the decline of the California tiger salamander is the conversion of habitat for urban and agricultural activities (T. Jones in litt. 1993; Service 2003a, 2004a, 2004b; Shaffer et al 1993). Some of the largest remaining subpopulations are in areas severely threatened by new urban development, including the Livermore Valley, Santa Clara Valley, and Fresno areas. In addition to direct loss of habitat, the widespread conversion of land to residential and agricultural uses has fragmented habitat throughout the range of the tiger salamander and has isolated remaining populations (Shaffer et al. 1993). Urban effects include housing, commercial, and industrial developments; road construction and widening; golf course construction and maintenance; trash dumping, landfill operation and expansion; and operation of gravel mines and quarries.

Agricultural effects include discing and deep-ripping; and cultivation, planting and maintenance of row crops, orchards, and vineyards. Historically, approximately 15.59 million acres of valley and coastal grasslands blue oak/foothill pine, valley oak, or mixed hardwood lands (Kuchler 1988), existed. Urbanization and intensive agriculture have eliminated virtually all valley grassland and oak savanna habitat from the Central Valley floor. Currently there are about 1.1 million acres where the tiger salamander potentially is still extant.

The relative loss of habitat has been even more extreme with respect to vernal pools, the historic breeding habitat of the tiger salamander. Remaining vernal pool complexes are now fragmented and reduced in area. Where vernal pools remain, they are often disturbed and degraded by drainage modification, overgrazing, off-road vehicle use, non-native plant invasion, trash dumping, road construction, and urban development (Jones and Stokes Associates 1987; Service 1994; Keeler-Wolf et al. 1998).

While the California tiger salamander does breed successfully in stock ponds, they often are poorer habitat for tiger salamanders than natural vernal pools. Hydroperiods may be so short that larvae cannot metamorphose, or so long that predatory fish and bullfrogs (*Rana catesbeiana*) can colonize the pond (Shaffer et al. 1993; Seymour and Westphal 1994). Extirpation of a tiger salamander occurrence is likely if fish are introduced (Shaffer et al. 1993; Seymour and Westphal 1994).

A number of nonnative species have adversely affected the California tiger salamander through predation and competition. A strong negative correlation exists between bullfrog presence and, tiger salamander presence (Shaffer et al. 1993; Seymour and Westphal 1994). Morey and Guinn (1992) documented a shift in amphibian community composition at a vernal pool complex, with salamanders becoming proportionally less abundant as bullfrogs increased in number. Western mosquitofish (*Gambusia affinis*) have also likely adversely affected tiger salamanders via predation and competition. Loredo-Prendeville et al. (1994) failed to find any tiger salamanders inhabiting ponds containing mosquitofish. About 50 local mosquito abatement districts plant the fish throughout the state (Boyce in litt. 1994).

A number of other non-native species have either been directly implicated in predation of tiger salamander or appear to have the potential for such. Introductions of largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), catfish (*Ictalurus* spp.), and fathead minnows (*Pimephales promelas*) likely eliminated tiger salamanders from several breeding sites in Santa Barbara County (Service 2000). Non-native sunfish, catfish, and bullheads (*Ameiurus* spp.) have been and still are widely planted in ponds in California for sportfishing. Crayfish (*Pacifastacus*, *Orconectes*, and *Procambarus* spp.) are also known to prey on California newt eggs and larvae, despite toxins they produce (Gamradt and Kats 1996).

Like most amphibians, tiger salamanders inhabit both aquatic and terrestrial habitats at different stages in their life cycle. Therefore, they are exposed to both aquatic and terrestrial pollutants due to their highly permeable skin (Blaustein and Wake 1990).

During 2001, the 23 counties where tiger salamanders occur used over 105 million pounds of pesticides (California Department of Pesticide Regulation Internet website, December 2002), some of which are extremely toxic to aquatic organisms, including amphibians and the organisms on which they prey. Some of these pesticides, such as chloropyrifos, malathion, and endosulfin are cholinesterase inhibitors. Reduced cholinesterase activity has been linked to uncoordinated swimming, increased vulnerability to predation, depressed growth, and increased mortality in tadpoles (Berrill et al. 1998; Bridges 1997; de Lamas et al. 1985; Rosenbaum et al. 1988; Sparling et al. 2001). Even when toxic or detectable amounts of pesticides are not found in breeding ponds or groundwater, salamanders may still be affected, particularly by chemicals applied during the migration and dispersal seasons. Sparling et al. (2001) examined pesticide usage and amphibian (*Rana* and *Bufo* spp.) population declines in California and provided evidence that pesticides are instrumental in declines of these species.

Widespread control of ground squirrels and pocket gophers may pose a significant threat to the tiger salamander. Ground squirrel control is done by trapping, shooting, fumigation, toxic (including anticoagulant) baits, and habitat modification, including deep-ripping of burrow areas (UCJPM Internet website, January 2003). Ground squirrel and pocket gopher control may have the indirect effect of reducing the number of upland burrows available to specific tiger salamander subpopulations (Loredo-Prendeville et al. 1994).

Light to moderate livestock (cattle, sheep, and horses) grazing is generally thought to be compatible with continued successful use of rangelands by the tiger salamander, provided the grazed areas do not also have intensive burrowing rodent control efforts (T. Jones, in litt. 1993; Shaffer et al. 1993; S. Sweet, personal communication 1998; Shaffer and Trenham, personal communication 2003). By maintaining shorter vegetation, grazing may make areas more suitable for ground squirrels whose burrows are essential to tiger salamanders.

Status with Respect to Recovery and Conservation Needs –
No recovery plan exists for this species. Conservation of the California tiger salamander requires a five-pronged approach: (1) maintaining the current genetic structure across the species' range; (2) maintaining the current geographic, elevational, and ecological distribution; (3) protecting the hydrology and water quality of breeding pools and ponds; (4) retaining or providing for connectivity between breeding locations for genetic exchange and recolonization; and (5) protecting sufficient barrier-free upland habitat around each breeding location to allow for sufficient survival and recruitment to maintain a breeding population over the long term. Specific actions that help meet these goals include, but are not limited to, protection, restoration,

and management of large blocks of contiguous aquatic and terrestrial habitat; management of stock ponds to eliminate or reduce populations of nonnative predators; elimination of nonnative tiger salamanders and their hybrids; and reduced exposure to contaminants, particularly in the vulnerable larval stages (Service 2004b, 2005).

Conservancy Fairy Shrimp

Listing -
The Conservancy fairy shrimp (*Branchinecta lynchi*) was listed as threatened on September 19, 1994 (Service 1994). Critical habitat was designated in 2003 (Service 2003b). The designation was revised in 2005 (Service 2005b), and species by unit designations were published in 2006 (Service 2006).

Description –
The Conservancy fairy shrimp is a small (about ½ to one inch long) Anostracan crustacean with a delicate elongate body, large stalked compound eyes, no carapace, and eleven pairs of swimming legs. They glide through the water upside down, swimming by beating their legs in a complex, wavelike movement.

Historical and Current Range –
The historical range is not well known. There are not many known populations. Known populations include (from north to south): (1) Vina Plains, Butte and Tehama counties; (2) Sacramento National Wildlife Refuge, Glenn County; (3) Yolo Bypass Wildlife Area, Yolo County; (4) Jepson Prairie, Solano County; (5) Mapes Ranch, Stanislaus County; (6) University of California, Merced, Merced County; (7) Vieira-Sandy Mush Conservation Bank; (8) Grasslands Ecological Area, Merced County and (9) Los Padres National Forest, Ventura County.

Essential Habitat Components –
Conservancy fairy shrimp typically inhabit large, cool-water vernal pools with moderately turbid water where they feed on algae, bacteria, protozoa, rotifers and bits of detritus (Eriksen and Belk 1999). It has been reported that the Conservancy fairy shrimp and vernal pool fairy shrimp are rarely found in the same pool at the same time (see Service 2005c and references therein). Generally the vernal pools this species is found in last until June, but active shrimp can only be collected in them usually from early November to early April.

Although usually the species is found in larger pools, it has recently been detected in smaller pools, too; the common underlying characteristic of occupied pools seems to be that they generally lack vegetation (B. Helm, pers. comm. to S. McDonald). The Vieira-Sandy Mush Conservation Bank, managed by the Center for Natural Lands Management, has lower-terrace vernal pools; the site is near the intersection of Sandy Mush Road and Hwy 59, well to the west of Highway 99.

Helm (1998) reported the results of both field and lab studies on several fairy shrimp species, including the Conservancy and vernal pool fairy shrimps. He found that the maximum ponded area of pools that the Conservancy fairy shrimp occurred in (19 pools in the sample) ranged from 30 to 356,253 m^2, with a mean of 27,865 m^2, and a standard deviation of 80,673. In the lab, in 10 plastic pool cultures studied from 1990 to 1996, Helm (1998) found that the Conservancy fairy shrimp takes 46.2 days (mean) to reproduce. This means that at 46.2 days, at least one individual female has two shelled cysts (to replace the parents). The standard error was 4.2. The mean longevity of the population (last individual dead) was 113.9 days. The vernal pool fairy shrimp took 39.7 days to reproduce (standard error of 1.9) and had 90.6 days longevity.

Reproductive Ecology –
Female fairy shrimp carry their eggs in a ventral brood sac. The eggs either are dropped to the pool bottom or remain in the brood sac until the mother dies and sinks. When the pool dries out, so do the eggs. They remain as cysts in the dry pool bed until rains and other environmental stimuli hatch them. The encysted shrimp are capable of withstanding heat, cold and prolonged periods of desiccation. When the pools refill, some, but not all, of the cysts may hatch. The cyst bank in the soil may contain cysts from several years of breeding. Hatching will generally begin within the same week that a pool starts to fill. The average time to maturity for Conservancy fairy shrimp is 49 days. In warmer pools, it can be as little as nineteen days (Eriksen and Belk 1999).

Dispersal –
The primary historical dispersal method for the Conservancy fairy shrimp may have been large scale flooding resulting from winter and spring rains that allowed the animals to colonize different individual vernal pools and other vernal pool complexes. This dispersal mechanism may no longer function in some areas due to the construction of dams, levees, and other flood control measures, and widespread urbanization within significant portions of the range of this species. Waterfowl and shorebirds are now considered the primary dispersal agents for vernal pool tadpole shrimp and vernal pool fairy shrimp (Brusca and Brusca 1992; Simovich et al. 1992). The eggs of these crustaceans are ingested (Krapu 1974; Swanson 1974; Driver 1981; Ahl 1991) and/or adhere to the legs and feathers where they are transported to new habitats.

Reasons for Decline and Threats to Survival –
The ephemeral wetlands that support this network of populations are remnants of what was formerly a pristine vernal pool ecosystem, which has been converted to primarily agricultural and urban uses. This highly disturbed remnant habitat is imperiled by a variety of human-caused activities, primarily urban development, water supply/flood control projects and conversion of land to agricultural use.

Holland (1978) estimated that between 60 and 85 percent of the habitat that once supported vernal pools, had been destroyed by 1973. Since 1973, a substantial amount of remaining habitat has been converted for other uses. The rate of loss of vernal pool habitat in the state has been estimated at two to three percent per year (Holland and Jain 1988).

Conversion of natural habitat for urban and agricultural uses has highly fragmented the habitat of the listed vernal pool crustaceans throughout their ranges. Fragmentation such as this results in small isolated fairy shrimp populations. Ecological theory predicts that such populations will be highly susceptible to extinction due to chance events, inbreeding depression, or additional environmental disturbance. If an extinction event occurs in a population that has been fragmented, the opportunities for recolonization are thought to be greatly reduced due to physical (geographical) isolation from other (source) populations (Gilpin and Soule 1986; Goodman

1987a,b). For the Conservancy fairy shrimp in particular, the concern is great because so few populations are known to exist.

Status with Respect to Recovery –
The *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005) provides recovery criteria for the Conservancy fairy shrimp. A five-year review was completed on October 9, 2007 and no change in listing status was recommended (Service 2007).

Vernal Pool Fairy Shrimp

Listing -
The vernal pool fairy shrimp (*Branchinecta lynchi*) was listed as threatened on September 19, 1994 (Service 1994). Critical habitat was designated in 2003 (Service 2003b). The designation was revised in 2005 (Service 2005b), and species by unit designations were published in 2006 (Service 2006a).

Description –
The vernal pool fairy shrimp is a member of the aquatic crustacean order Anostraca and is endemic to vernal pools in the Central Valley, eastern coastal foothills from Tehama to Riverside Counties, and a limited number of sites in the Transverse Range and Santa Rosa Plateau of California (Eng et al. 1990; Sugnet & Associates 1993; Service 1994), as well as Jackson County, Oregon. It ranges in size from 0.4 to 1.0 inch.

Historical and Current Range –
The vernal pool fairy shrimp is found from Jackson County near Medford, Oregon, throughout the Central Valley, and west to the central Coast Ranges. Isolated southern populations occur on the Santa Rosa Plateau and near Rancho California in Riverside County (Eng et al. 1990; Eriksen and Belk 1999). This species, however, occurs sporadically in local vernal pool complexes. The total population of vernal pool fairy shrimp is known from fewer than 40 locations, about a quarter of which are represented by a single pool.

Essential Habitat Components –
This species is usually associated with vernal pools but are also found in association with other ephemeral habitats including alkali pools, seasonal drainages, stock ponds, vernal swales, and rock outcrops. Critical habitat within the action area contains the only known location of vernal pool fairy shrimp in sandstone outcrop pools Examples of artificially created ephemeral habitats include railroad toe-drains, roadside ditches, abandoned agricultural drains, ruts left by heavy construction vehicles, and depressions in firebreaks (Eng et al. 1990).

Water chemistry is one of the most important factors in determining the distribution of vernal pool fairy shrimp. The pools that vernal pool fairy shrimp inhabit have low conductivity, total dissolved solids, alkalinity, and chloride levels, and a pH range of 6.3-8.5 and a temperature range of 4.5-23 C. These pools typically are clear to tea-colored and occur most commonly in grass- or mud-bottomed swales or basalt lava flow depressions in unplowed grasslands. Single populations, however, are known to occur in a sandstone rock outcrop and an alkaline vernal pool (Service 1994).

Reproductive Ecology –
The life span of the vernal pool fairy shrimp is relatively short, allowing it to hatch, mature to adulthood, and reproduce during the short time period when vernal pools dry. Beyond inundation of the habitat, the specific cues for hatching are unknown although temperature is believed to play a large role (Eriksen and Belk 1999). The population survives through the dry summer months as diapaused eggs in the pool sediment. Some of these eggs will hatch when the pool fills with water in subsequent seasons, while the remaining eggs remain in the sediment. Eggs contained in the sediment at any given point can represent eggs deposited from several breeding seasons. The early stages of fairy shrimp rapidly develop into adults whose populations disappear long before the vernal pools dry up.

Dispersal –
The primary historical dispersal method for the vernal pool fairy shrimp may have been largescale flooding resulting from winter and spring rains that allowed the animals to colonize different individual vernal pools and other vernal pool complexes. This dispersal mechanism may no longer function in some areas due to the construction of dams, levees, and other flood control measures, and widespread urbanization within significant portions of the range of this species. Waterfowl and shorebirds are now considered the primary dispersal agents for vernal pool tadpole shrimp and vernal pool fairy shrimp (Brusca and Brusca 1992; Simovich et al. 1992). The eggs of these crustaceans are ingested (Krapu 1974; Swanson 1974; Driver 1981; Ahl 1991) and/or adhere to the legs and feathers where they are transported to new habitats.

Reasons for Decline and Threats to Survival –
The ephemeral wetlands that support this network of populations are remnants of what was formerly a pristine vernal pool ecosystem, which has been converted to primarily agricultural and urban uses. This highly disturbed remnant habitat is imperiled by a variety of human-caused activities, primarily urban development, water supply/flood control projects and conversion of land to agricultural use.

Holland (1978) estimated that between 60 and 85 percent of the habitat that once supported vernal pools, had been destroyed by 1973. Since 1973, a substantial amount of remaining habitat has been converted for other uses. The rate of loss of vernal pool habitat in the state has been estimated at two to three percent per year (Holland and Jain 1988).

Conversion of natural habitat for urban and agricultural uses has highly fragmented the habitat of the listed vernal pool crustaceans throughout their ranges. Fragmentation such as this results in small isolated fairy shrimp populations. Ecological theory predicts that such populations will be highly susceptible to extinction due to chance events, inbreeding depression, or additional environmental disturbance. If an extinction event occurs in a population that has been fragmented, the opportunities for recolonization are thought to be greatly reduced due to physical (geographical) isolation from other (source) populations (Gilpin and Soule 1986; Goodman 1987).

Status with Respect to Recovery –
The *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005) provides recovery criteria for the vernal pool fairy shrimp. A five-year review was

completed on October 9, 2007 and no change in listing status was recommended (Service 2007d). The species' status statewide is declining.

<u>*Vernal Pool Tadpole Shrimp*</u>

Listing -
The vernal pool tadpole shrimp (*Lepidurus packardi*) was listed as threatened on September 19, 1994 (Service 1994). Critical habitat was designated in 2003 (Service 2003b). The designation was revised in 2005 (Service 2005b), and species by unit designations were published in 2006 (Service 2006a).

Description –
Vernal pool tadpole shrimp is a member of the aquatic crustacean order Notostraca. Vernal pool tadpole shrimp have large, shield-like carapaces, typically less than 2.5 cm (one inch) long, that cover most of their body. They have dorsal, compound eyes, and a pair of long cercopods, one on each side of a flat caudal plate, at the end of their last abdominal segment.

Historical and Current Range –
The species is endemic to vernal pools throughout the Central Valley. Known populations are in the north, east of Shasta County south to the San Luis National Wildlife Refuge in Merced County, and in a single vernal pool complex located on the San Francisco Bay National Wildlife Refuge in Alameda County (Service 1994).

Essential Habitat Components –
Vernal pool tadpole shrimp inhabit alkaline pools, clay flats, ditches, freshwater marshes, stream oxbows, vernal lakes, vernal pools, vernal swales, and other seasonal wetlands (Helm 1998). Occupied habitats range in size from vernal pools as small as two square meters to large vernal lakes up to 36 hectares (89 acres); the potential ponding depth of occupied habitat ranges from four cm (1.5 inches) to 1.5 meters (59 inches).

Important factors influencing their prevalence and persistence in pools include: the absence or presence of water during specific times of the year, the duration the water persists, and water chemistry that includes salinity levels, conductivity, amount of dissolved solids, and pH (Service 1994). The pools inhabited typically contain clear to highly turbid water with very low conductivity, total dissolved solids, and alkalinity. Clear-water pools occur mostly in grass-bottomed swales in grasslands having established alluvial soils underlain by hardpan. The turbid water habitats are associated with mud-bottomed pools.

Habitat Use and Foraging Ecology –
Unlike fairy shrimp, vernal pool tadpole shrimp swim with their legs down, climb on objects, and plow through sediments on the pool bottom (Service 1994). Their omnivorous diet contributes to the importance of their ecological role in vernal pool communities. Vernal pool tadpole shrimp consume detritus, earthworms, mollusks, dead tadpoles, frog eggs, fairy shrimp, and a variety of other invertebrates and microorganisms (Pennak 1989; Service 1994). The vernal pool tadpole shrimp matures slowly and is long-lived, so the adults are often present and reproductive until the pools dry up in spring.

Reproductive Ecology –
Female tadpole shrimp produce up to six clutches of eggs per season, yielding more than 800 eggs in all, which are deposited on vegetation at the bottom of the pool. Cysts may hatch at various times, anywhere from one hour to three weeks after the pools are inundated. The exact hatching stimuli are unknown. A portion of the eggs will hatch immediately while the rest enter diapause (dormancy). Adults remain present and reproductively active until the pools evaporate. Like fairy shrimp, the population survives through the dry summer months as diapaused eggs in the pool sediment. Some of these eggs will hatch when the pool fills with water in subsequent seasons, while the remaining eggs remain in the sediment (Service 1994). Eggs contained in the sediment at any given point can represent eggs deposited from several breeding seasons.

Vernal pool tadpole shrimp reach maturity three to four weeks after initial inundation of the vernal pool. Vernal pool tadpole shrimp mature more slowly than fairy shrimp, and are longer lived. Typically, adults will survive until the vernal pool dries or until temperatures of 10 to 15 degrees Celsius are reached. Vernal pool tadpole shrimp can begin shedding cysts in as little as 15 days.

Dispersal –
The primary historical dispersal method for the vernal pool tadpole shrimp may have been large scale flooding resulting from winter and spring rains that allowed the animals to colonize different individual vernal pools and other vernal pool complexes. This dispersal mechanism may no longer function in some areas due to the construction of dams, levees, and other flood control measures, and widespread urbanization within significant portions of the range of this species. Waterfowl and shorebirds are now considered the primary dispersal agents for vernal pool tadpole shrimp and vernal pool fairy shrimp (Brusca and Brusca 1992; Simovich et al.1992). The eggs of these crustaceans are ingested (Krapu 1974; Swanson 1974; Driver 1981; Ahl 1991) and/or adhere to the legs and feathers of birds, whereby they are transported to new habitats.

Reasons for Decline and Threats to Survival –
The vernal pool tadpole shrimp is in danger of extinction principally as the result of flood control, highway, and utility projects; urban development; conversion of native habitats to agriculture; and stochastic events by virtue of the small isolated nature of many of the remaining populations (Service 1994). Habitat loss can occur from the direct destruction and modification of pools attributable to filling, grading, disking, or leveling. In fact, any activity or disturbance that alters the hydrologic regime of an area containing vernal pools may reduce the population size or reproductive success of these animals or eliminate them altogether. The species was listed as endangered by the Service in 1994 largely because of the significant threats associated with future habitat loss and fragmentation (Service 1994). The State of California has not designated the species with any special status (CNDDB 2010).

Status with Respect to Recovery –
The *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005) provides recovery criteria for the vernal pool tadpole shrimp. A five-year review was completed on October 9, 2007 and no change in listing status was recommended (Service 2007e). The species' status statewide is declining.

Palmate-bracted Bird's-beak

Listing –
This species was listed as endangered by the Service on July 1, 1986 (Service 1986). Critical habitat has not been proposed.

Description –
Palmate-bracted bird's-beak (*Cordylanthus palmatus*) is an annual herb in the snapdragon family (Scrophulariaceae). The plants are 4–12 inches tall and highly branched. The stems and leaves are grayish green and sometimes covered with salt crystals excreted by glandular hairs. Small, pale whitish flowers, ½-inch to 1 inch long, are arranged in dense clusters (spikes) and densely surrounded by herbaceous leaf-like bracts. Like other *Cordylanthus* species, the petals are divided into two lips. The upper one is shaped like a bird's-beak, leading to the common name of the genus.

Historical and Current Range –
Historically, the species is known from scattered locations in San Joaquin, Fresno and Madera Counties in the San Joaquin Valley, Yolo, and Colusa Counties in the Sacramento Valley, and the Livermore Valley area of Alameda County. Saline-alkali soils and alkali sink scrub habitats historically were rare in central California, and those few that did exist have been greatly reduced by soil reclamation and draining of seasonal wetlands, conversion of land to agricultural use, urbanization, livestock grazing, and more recently by off-road vehicle use and trash dumping. The rarity of saline-alkali soils with natural vegetation and the intensive agricultural and urban development within the species' range make the likelihood of finding additional colonies remote.

It is currently known to occur in 21 locations in the Sacramento, Livermore, and San Joaquin Valleys. These include Sacramento National Wildlife Refuge in Glenn County, Delevan National Wildlife Refuge in Colusa County, Colusa National Wildlife Refuge in Colusa County, and the combined Alkali Sink Ecological Reserve and Mendota Wildlife Area.

Life History and Reproductive Ecology –
Like other members of *Cordylanthus* and related genera, palmate-bracted bird's-beak is partially parasitic on the roots of other plants. Its host plant may be salt grass (*Distichlis spicata*). As a result of its hemiparasitism, salt excretion and a deep root system, palmate-bracted bird's-beak is well adapted to harsh environments with long, hot summers and saline soils (Coats et al. 1993).

Palmate bracted bird's-beak grows on seasonally flooded, saline-alkali soils in lowland plains and basins at elevations of less than 500 feet. In these areas, it grows primarily along the edges of channels and drainages, with a few individuals scattered in seasonally wet depressions, alkali scalds (barren areas with a surface crust of salts) and grassy areas. Palmate-bracted bird's-beak grows in valley sink scrub and alkali meadow natural communities in association with other species tolerant of high salt concentrations, such as iodine bush (*Allenrolfea occidentalis*), alkali heath (*Frankenia salina*), glasswort (*Salicornia subterminalis*), seepweed (*Suaeda moquinii*) and salt grass (*Distichlis spicata*).

The flowering period is May-October (Skinner and Pavlik 1994). Most pollination is by *Bombus* spp. and both self- and cross-pollination occurs. Seedlings grow in late March or April. The species has a persistent seedbank. Seasonal short-term overland flooding may disperse seeds and promote seed germination by diluting the saline soils (Coats et al. 1993) - in laboratory tests, seed germination rates were significantly higher in low-salinity than in high-salinity solutions, regardless of alkalinity (Center for Conservation Biology 1991). However, prolonged flooding would not be conducive to survival of palmate-bracted bird's-beak (A. Howald pers. comm., cited in Service 1998).

Population fluctuations are common in palmate-bracted bird's-beak. These oscillations may be a result of changes in pollination success, rainfall patterns, freshwater influence, and marsh pollution. Despite the formation of a persistent seedbank, the number of plants in a population varies yearly in response to environmental conditions, particularly precipitation (Center for Conservation Biology 1994) thereby making single-season surveys unreliable.

Reasons for Decline and Threats to Survival –
Agricultural conversion eliminated the formerly known palmate-bracted bird's-beak beak populations near College City, Kerman, and southeast of Mendota; reduced the size of the Woodland population: and destroyed extensive areas of potential habitat in the Sacramento and San Joaquin Valleys. Urban development was responsible for the destruction of the Stockton occurrence.

Urban expansion (including commercial uses, residential development, and construction of recreational facilities) poses imminent threats at the Springtown and Woodland sites. Numerous other factors threaten the remaining populations. Changes in the hydrologic regime (seasonal watercycles and movements) by drainage, diking, and channelization have interrupted the seasonal overland flows and altered water salinity at Springtown, Woodland, and on lands adjacent to the Alkali Sink Ecological Reserve and National Wildlife Refuges. Because of the lack of genetic variability within and among the Sacramento Valley populations and the limited number of individuals in the Alkali Sink Ecological Reserve, western Madera County, and Woodland populations, random or catastrophic events could result in elimination. Road maintenance is a potential threat at the Alkali Sink Ecological Reserve. The Springtown metapopulation faces many additional threats, including unauthorized fill of wetlands, encroachment by exotic plant species, off—road vehicle use, and livestock being allowed in seasonal pools (Coats et al. 1993; Center for Conservation Biology 1994; CNDDB 2010).

Status with Respect to Recovery –
A five-year review was completed in June 2009 (Service 2009). No change in status was recommended. The recovery criteria in the Recovery Plan for Upland Species of the San Joaquin Valley (Service 1998) include several measures to protect metapopulations and the habitat that connects them. Elements of the strategy are to protect land in blocks of at least 65 hectares (160 acres) and to avoid fragmenting any metapopulation into more than two blocks of contiguous protected natural land. Buffer zones of 500 feet or more should be protected beyond the population margins to reduce external influences, provide pollinator habitat, and allow for population expansion. Finally, the natural hydrological regime, including appropriate height of the water table and periodic overland flows, must be maintained to ensure long-term survival at protected sites.

<u>*Greene's Tuctoria*</u>

Listing -
Greene's tuctoria (*Tuctoria greenei*) was listed as endangered on March 26, 1997 (Service 1997). Critical habitat was designated in 2003 (Service 2003b). The designation was revised in 2005 (Service 2005b), and species by unit designations were published in 2006 (Service 2006).

Description –
Greene's tuctoria is a small tufted annual in the grass family (Poaceae) and tribe Orcuttieae that blooms May–September (CNPS 2001). Like all plants in the Orcuttieae, Greene's tuctoria is dependent on vernal pools for survival. Tuctoria species have short-toothed, narrow lemmas (scale-like appendages at florets), and the juvenile and terrestrial leaves of *Tuctoria* are similar to those of *Orcuttia*, but *Tuctoria* does not produce the floating type of intermediate leaves (Stone et al. 1988).

Historical and Current Range –
After its discovery in Butte County in 1890, Greene's tuctoria was not reported again for over 40 years. However, during extensive surveys in the late 1930's, Hoover (1937, 1941) found the species at 12 sites in Fresno, Madera, Merced, San Joaquin, Stanislaus, Tehama, and Tulare Counties. In fact, he described it as the most common of all *Orcuttia* species, with which it was classified at the time. Greene's tuctoria has been reported in ten counties, which include Shasta, Tehama, Butte, Glenn, San Joaquin, Stanislaus, Madera, Merced, Fresno, and Tulare. The Service is aware of 53 localities of this species (CNDDB 2010; Service 2005).

Of the 53 known localities, only 30 localities are presumed to be extant (CNDDB 2010; Service 2005). This species is believed to be extirpated from San Joaquin, Madera, Fresno, and Tulare counties (Service 2005). The largest concentration of the presumed extant localities are located in the Vina Plains area, in Tehama and Butte counties, where 16 localities are presumed extant (CNDDB 2010). The next largest concentration of localities is in eastern Merced County, where five localities are presumed extant (CNDDB 2010; Vollmar 2002). Stone et al. (1988) conducted the most recent comprehensive survey effort for this species, in which all known localities were visited in 1986 and 1987. According to the CNDDB (2010), a large percentage of the known localities have not been surveyed in the last 20 years. Because surveys have not been performed at many of these sites in over twenty years, the actual status of many of the localities is not known at this time.

Essential Habitat Components –
Greene's tuctoria is relatively less tolerant to long periods of water inundation compared to other species in the tribe Orcuttieae, and is typically found along the margins of deeper vernal pools instead of in the deeper portions of the pools (Stone et al. 1988).

Reproductive Ecology and Demography –
Optimum germination of Greene's tuctoria seed occurs when the seed is exposed to light and anaerobic conditions after stratification (Keeley 1988). Germination occurs about 2 months following inundation (Keeley 1998). *Tuctoria* seedlings do not develop floating juvenile leaves, as does *Orcuttia* (Griggs 1980; Keeley 1998). The plants apparently do not tolerate inundation; all five *T. greenei* plants in a Glenn County pool died when the pool refilled during late spring

rains in 1996 (J. Silveira in litt. 1997). Greene's tuctoria flowers from May to July (Skinner and Pavlik 1994), with peak flowering in June and July (Griggs 1981; Broyles 1987).

As with other vernal pool annuals, population size in Greene's tuctoria varies widely from year-to-year, and populations that have no visible plants one year can reappear in large numbers in later years. Population fluctuations may be due to annual variations in weather, particularly rainfall, to changes in management, or combinations of the two. Such fluctuations were observed at scattered sites in Butte and Tehama Counties during the 1970's (Griggs 1980; Griggs and Jain 1983) and at Sacramento National Wildlife Refuge, where the population in the single occupied pool ranged from zero to 60 plants between 1994 and 1999 (J. Silveira in litt. 2000). Fluctuations of as much as three orders of magnitude were documented on the Vina Plains Preserve during the 1980's and 1990's; the high 1995 population estimates followed a winter of favorable rainfall (Alexander and Schlising 1997) and long period without livestock grazing; cattle grazing on the Vina Plains Preserve was discontinued in the growing season of 1987-1988 and did not resume until the growing season of 1995-1996 (D. Alexander in litt. 1998).

However, populations that decline to zero and then do not reappear under favorable conditions may in fact be extirpated. A Stanislaus County population (Element Occurrence 39) numbered fewer than 100 plants in 1973, dropped to two the following year, and remained at zero for the next three years (Griggs 1980; Griggs and Jain 1983). The population was not monitored for the following decade. Although the vernal pool was still intact as of 1986, Greene's tuctoria was not observed during surveys that year; however, the winter had been drier than average. In 1987, following a winter of favorable rainfall, Greene's tuctoria still was not present, even though *Neostapfia colusana* was found in large numbers (Stone et al. 1988). The area had been "rather heavily grazed" in 1987 (Stone et al. 1988), but livestock grazing intensity during the 1970's is not known.

Habitat Use –
Greene's tuctoria has been found in three types of vernal pools: Northern Basalt Flow, Northern Claypan, and Northern Hardpan (Sawyer and Keeler-Wolf 1995) on both low and high terraces (Stone et al. 1988). Occupied pools are or were underlain by iron-silica cemented hardpan, tuffaceous alluvium, or claypan (Stone et al. 1988). Of pools where the species was known to be extant in 1987, the median size was 0.6 hectare (1.5 acres), with a range of 50 square meters (0.01 acre) to 3.4 hectares (8.4 acres) (Stone et al. 1988). Stone et al. (1988) noted that Greene's tuctoria grew in shallower pools than other members of the tribe or on the shallow margins of deeper pools, but they did not quantify pool depth. At the Vina Plains, Greene's tuctoria grew in pools of "intermediate" size, which dried in April or early May of 1995 (Alexander and Schlising 1997). The Central Valley pools containing Greene's tuctoria are (or were) in grasslands; the Shasta County occurrence is surrounded by pine forest (CNDDB 2010). Occupied pools in the Central Valley are (or were) at elevations of 33.5 to 134 meters (110 to 440 feet) (Stone et al. 1988), whereas the Shasta County occurrence is at 1,067 meters (3,500 feet) (CNDDB 2010).

In the Northeastern Sacramento Valley Vernal Pool Region, Greene's tuctoria grows mostly on Anita clay and Tuscan loam soils, with one occurrence on Tuscan stony clay loam. Soil types are not certain for several other occurrences in this region; one is on either the Rocklin or the San Joaquin series, and the others are unknown. The single occurrence in the Solano-Colusa Vernal

Pool Region is on strongly saline-alkaline Willows clay (J. Silveira in litt. 2000). In the Southern Sierra Foothills Vernal Pool Region, Greene's tuctoria is known to grow on a number of different soil series including Archerdale, Bear Creek, Exeter, Meikle, Ramona, Raynor, Redding, and San Joaquin. Soil types have not been determined for occurrences in the other regions.

At the Vina Plains Preserve, frequent associates of Greene's tuctoria are *Eryngium castrense* and *Marsilea vestita* (Alexander and Schlising 1997). Elsewhere in the Sacramento Valley and in the San Joaquin Valley, Greene's tuctoria often grows in association with *E. vaseyi*, *Plagiobothrys stipitatus*, and *Alopecurus saccatus* (foxtail). The rare *Chamaesyce hooveri* co-occurs with Greene's tuctoria at six sites in the Sacramento Valley. Other rare plants that grow in the same vernal pools with Greene's tuctoria at one or two occurrences are: *Orcuttia pilosa*, *O. tenuis*, and *Gratiola heterosepala* (Broyles 1987; Stone et al. 1988; CNDDB 2010).

Reasons for Decline and Threats to Survival –
Stone et al. (1988) estimated that 66 percent of the pre-agricultural localities of Greene's tuctoria have been extirpated, primarily from the elimination of habitat through development of irrigated agriculture (Stone et al. 1988; CNDDB 2010). All of the Greene's tuctoria localities that were located on lower terrace or claypan soils have been extirpated, presumably because these soil types are relatively fertile and therefore more suitable for intensive agriculture (Stone et al. 1988). With the exception of the locality on the Drayer Ranch Conservation Bank, all of the localities of Greene's tuctoria remaining in the San Joaquin Valley (Merced County) are threatened by continuing agricultural development (Stone et al. 1988; Vollmar 2002). All of the remaining localities within Merced County have documented trends towards a decline in both overall numbers of plants as well as area of suitable habitat within a given pool due to discing, heavy cattle grazing, invasion of weedy non-native plants, and flooding (Vollmar 2002). This species is more susceptible to grazing impacts and grasshopper outbreaks compared to other species in the tribe Orcuttieae (Griggs and Jain 1983; Stone et al. 1988). The actual effect of such predation on subsequent plant population size has not been assessed.

Status with Respect to Recovery –
The *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005) provides recovery criteria for Greene's tuctoria. A five-year review was completed in December 2007 and no change in listing status was recommended (Service 2007b). The extreme edges of this species' range are not protected. The northern-most locality occurs in Shasta County and this locality is on private land and not protected. Extirpated localities in Madera, Fresno, and Tulare counties once represented the southern extent of this species' range. Currently, the southernmost localities of this species are in Eastern Merced County, where only one of five localities is protected within the Drayer Ranch Conservation Bank.

Environmental Baseline

The environmental baseline covers the past and present impacts of all federal, State, or private actions and other human activities in an action area, the anticipated impacts of all proposed federal projects in an action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions that are contemporaneous with the consultation in process (50 CFR §402.02). Little information is available that would describe the land uses that have affected listed species on the ranch although MID has reported that there have been periods of time when vegetation was tall and when rodenticide was used extensively on site (Urrutia, pers. comm.).

Status of the Species within the Action Area

Blunt-nosed Leopard Lizard

Historical records indicate the presence of blunt-nosed leopard lizards in the vicinity of Madera Ranch and on Madera Ranch in 1989 and 1990. ICF biologists conducted walking transect surveys in 2000 (J&S 2005). At that time, no confirmed sightings were made, however, sixty-two percent of the July and August 2000 transect surveys, were not in the protocol window of May and June.

Focused surveys for blunt-nosed leopard lizard took place between May 5 and July 17, 2009 east of Gravelly Ford canal on the project site. Blunt-nosed leopard lizards were observed at five locations during these surveys (Kelly et al 2009). During burrow surveys in the weeks prior to focused blunt-nosed leopard lizard surveys, blunt-nosed leopard lizard had been documented at two locations and possibly sighted, but unconfirmed at two additional locations. After one additional suspected sighting and one additional confirmed sighting the lead biologist determined that there would not be additional value in continuing blunt-nosed leopard lizard surveys as presence was confirmed in sections 3, 10, 15, and 14 and the surveyors concluded that blunt-nosed leopard lizard have the potential to occur throughout the ranch. This is because of the suitability, contiguity, and large expanse of habitat, and the large area requirements for the species (Kelly et al 2009). Kangaroo rat and ground squirrel burrows, which are essential for blunt-nosed leopard lizard survival, are very abundant throughout the ranch. Also, primary prey species—grasshoppers and side-blotched lizards (*Uta stansburiana*)—were relatively common throughout the ranch (Kelly et al 2009).

There is likely a low density of blunt-nosed leopard lizards in grassland and iodine bush habitat throughout Madera Ranch. The habitat is not of the same high quality as that in other areas (e.g. Lokern), but clearly supports a population. Madera Ranch harbors the most northerly known population of blunt-nosed leopard lizards on the floor of the San Joaquin Valley. This is a significant ecological finding and it is also significant for blunt-nosed leopard lizard recovery planning (Service 1998).

California Tiger Salamander

Protocol level surveys for California tiger salamanders have not been conducted on Madera Ranch although there is suitable breeding and refugial habitat for California tiger salamanders present on Madera Ranch. No evidence of this species was found on the ranch during the reconnaissance-level surveys that was conducted by ICF biologists in 2000 (J&S 2005) for vernal pool crustaceans on Madera Ranch. On March 23, 2010, CDFG biologists sampled all pools on Madera Ranch plus one watering trough (CDFG 2010). Overall, the entire site was dry and only a few vernal pools had any water, despite the water year for 2009/2010 being average or slightly above average. Almost all of the wetted pools observed during this site visit were located along road embankments. Many of the vernal pools appeared to be better characterized as alkali playa.

There were two locations with large amounts of standing water. One location was in the eastern swale with an approximate average depth of 20 inches and used for water delivery across the site (Township 12 S, Range 16 E, Section 14). The other was a pond with an approximate average depth of 22 inches located in the southeastern corner of the ranch (Township 12, Range 16 E, Section 28). Both of these locations were sampled by dip netting and seine netting. The eastern swale did not have any vernal pool crustaceans or amphibian larvae. However, adult bullfrogs, crayfish, and mosquito fish were detected along with water boatman (Corixidae) and backswimmers (Notonectidae). The southeast pond had only very small Western toad (*Bufo boreas*) larvae. The pond had a significant amount of green algae, which may have depleted the oxygen to a level where only very small organisms could survive.

The nearest documented occurrence of California tiger salamanders from Madera Ranch is 5.3 miles (CNDDB 2006). No pitfall trapping has ever been conducted in upland areas on Madera Ranch. Based upon the lack of protocol-level surveys, none of the vernal pools or upland habitat on-site can be definitely ruled out as aquatic habitat for the species (BOR 2011).

<u>Fresno Kangaroo Rat</u>

From August 28–October 6, 2000, California State University, Stanislaus Endangered Species Recovery Program (ESRP) conducted 11,120 trap nights for kangaroo rats throughout Madera Ranch (ESRP 2000). Prior to the initiation of trapping, ICF biologists conducted surveys for active kangaroo rat burrows by walking sixteen, mile-long transects in each section. Locations were mapped for each cluster of 10 or more burrows in any given area (approx. 15' radius). From this survey a burrow density map was created by ICF. ESRP biologists who worked extensively on Madera Ranch found a high level of correspondence between the burrow density map and the actual distribution of kangaroo rat sign throughout the ranch property. Altogether, 61 trapping locations were selected throughout Madera Ranch. Groups of locations were trapped for five consecutive days, starting on 28 August 2000 and ending on 6 October 2000. The number of traps set at any given location depended on the amount of kangaroo rat activity found; areas with abundant sign were trapped more intensively. No Fresno kangaroo rats were captured. A total of 436 Heermann's kangaroo rats (*Dipodomys heermanni*) were trapped. ESRP concluded that the species could still be present in uncultivated parts of Madera Ranch, although the species clearly could not have been common on the property.

In 2009, ESRP conducted more intensive surveys for the swales and hard infrastructure areas east of the Gravelly Ford Canal plus a border area (ESRP 2009). ESRP conducted walking transects of Madera Ranch on April 20, 2009 within the facility corridors and swale areas. While walking these areas, ESRP identified burrow complexes of various sizes. Based on the burrow information, a trapping design was created. Trapping began the week of May 4, 2009 and ended the week of June 22, 2009, with a week-long break leading up to and including the full moon. Of a total of 6,238 trap nights, ESRP captured 396 Heermann's kangaroo rats 1,591 times.

Both surveys were conducted with appropriate protocols, but the second survey was more intensive and provides more up-to-date information. The best evidence indicates that the Fresno kangaroo rat currently does not occur on Madera Ranch east of the Gravelly Ford Canal. The habitat is very homogeneous and the lack of shrub cover may favor Heermann's kangaroo rats. This result cannot be extrapolated to the portion of Madera Ranch that lies west of the Gravelly Ford Canal because the Service remains concerned about total trapping density in this area. Any of the uncultivated grassland and iodine bush habitat could be used by the Fresno kangaroo rat, although the July 19, 2010 site visit indicates that the former center pivot areas are generally less suitable and probably currently only have more suitable habitat along the edges (e.g. fence lines, roads, etc.).

As indicated in the biological assessment (BOR 2011), and the survey reports (Kelly et al 2000, Kelly et al 2009) heavy grazing has occurred on the ranch. Kelly et al (2000) indicated that, "It is possible that the long history of cattle grazing on Madera Ranch has altered the ecosystem to the extent that it now is more suitable for Heermann's kangaroo rats. They in turn, by virtue of their size-mediated dominance, may be competitively excluding the much smaller Fresno kangaroo rat in the altered landscape. Madera Ranch has a very low level of shrub cover; we presume as a result of its long history of cattle grazing. Shrub cover is important to San Joaquin kangaroo rats; the short-nosed kangaroo rat (*D. n. brevinasus*) spends significantly more time foraging under shrubs where the perceived risk of predation is lower (Peyton 1995)."

The Recovery Plan for Upland Species of the San Joaquin Valley (Service 1998) includes as a recovery action the need to protect natural land between the Alkali Sink Ecological Reserve and the San Joaquin River to the north (Sandy Mush Road/South Grasslands Area). The plan recognizes that the largest block of natural land within the species' range is in western Madera County.

<u>San Joaquin Kit Fox</u>
San Joaquin kit foxes have been documented in Madera County near Madera Ranch. Suitable foraging habitat is present, kangaroo rats are abundant, and potential den sites are present in every section of the ranch. No positive evidence of occurrence of this species was found on the ranch during the reconnaissance-level surveys (including spotlighting) conducted by ICF (J&S 2005). Additionally, during these surveys, coyotes were often observed on the ranch. Although coyotes are known dominant competitors/predators of kit foxes (Cypher and Spencer 1998), kit foxes have evolved with coyotes and use multiple dens to escape them. Nevertheless, the presence of coyotes may be a limiting factor for kit foxes on the Madera Ranch. The surrounding farmlands provide much better habitat for coyotes (which don't require dens except for pupping), whereas kit foxes are precluded from denning in croplands. Additionally, the presence of the kit fox on the ranch is less likely because of the high fragmentation of the surrounding landscape and the at-best limited habitat connectivity with other population-sustaining habitat patches in the lower San Joaquin Valley.

The San Joaquin kit fox may occur in the action area at a low abundance. San Joaquin kit foxes have large home ranges and their population sizes can fluctuate from year-to-year, such that the reconnaissance-level surveys may not have detected the species. The action area is within recovery satellite area number four, which means the area has been identified as an area in the recovery plan that may periodically harbor kit foxes originating from a core area. Populations in satellite areas may be extirpated when conditions are poor for the species but then be recolonized by immigrants from core areas when conditions improve and numbers in the core areas increase.

Greene's Tuctoria

There is one documented occurrence of Greene's tuctoria near the project action area approximately six miles northeast of the City of Madera. However, this record is old (1936) and the population is believed to be extirpated (CNDDB 2010). Although this record is in the Southern Sierra Foothill vernal pool region and not the San Joaquin Valley vernal pool region, CNDDB reports mention occurrences not only in Northern Hardpan vernal pools but also in Northern Claypan vernal pools, playas, swales, and shallow "vernal depressions." The species has some potential to occur on Madera Ranch (E. Cypher, pers. comm. to S. McDonald).

Surveys for summer-blooming species were conducted on June 5 and 6, 2000 by ICF botanists (Jones and Stokes 2000). These detailed ground surveys of Sections 15, 16, 17, 20, 21, 22, 28, and 29 focused on habitat for the summer-blooming species identified during the April surveys. All deeper, longer-duration vernal pools were examined for summer-blooming species and none were discovered. Reference populations were not checked beforehand.

Additional botanical surveys were performed at Madera Ranch on April 14 and 15 and August 6 and 7, 2009 (ICF Jones and Stokes 2009). Reference populations were checked first. The survey area consisted of approximately 350 acres of swales to which recharge flows would be applied during the project's Phase 1. No federally-listed threatened or endangered plant species were found in the study area.

Greene's tuctoria may occur in any of the pools (37.5 total acres) on Madera Ranch, although previous surveys did not indicate it was present and other scientists believe it is unlikely to be present because the habitat is substantially different than pools that typically support this species (Preston pers. comm.).

Palmate-bracted Bird's-beak

Suitable habitat is present for this species on Madera Ranch, especially in the swales. Progressive desiccation of the ranch, with a dropping water table over the years may have made habitat in Section 7 and in other areas of the ranch unsuitable for this species (Preston pers. comm. to S. McDonald). Also, the hydrology has been altered, resulting in less sheet flooding, which is believed to be needed to allow germination (E. Cypher pers. comm. to S. McDonald). Whether or not a seed bank may persist on Madera Ranch is unknown. The species does not have especially thick seed coats (E. Cypher pers. comm. to S. McDonald), so although it forms a seed bank, it might not be able to persist for a lengthy period (i.e. several decades).

ICF botanists conducted reconnaissance-level surveys of the entire ranch in February and March 2000, except for cultivated areas (Sections 1, 13, and 21; the eastern half of Section 14; the northeastern quarter of Sections 4 and 22; the southeastern quarter of Section 16; and the western edge of Section 22).

Sections 15, 16, 17, 20, 21, 22, 28, and 29 were assessed with detailed ground surveys. Early blooming season floristic surveys were conducted during the week of April 3–7, 2000. These detailed ground surveys were conducted by walking transects at approximately 150-foot intervals and recording all plants encountered. All plants in bloom were identified to at least the species taxonomic level. Reference populations were not checked beforehand.

Surveys for summer-blooming species were conducted on June 5 and 6, 2000. These detailed ground surveys of Sections 15, 16, 17, 20, 21, 22, 28, and 29 focused on habitat for the summer-blooming species identified during the April surveys. On June 27, 2000, the northern half of Section 7 was surveyed by walking meandering transects across the section to search for palmate-bracted bird's-beak. The northern half of Section 7 provided the principal potential habitat for this species, which was identified in the earlier surveys (J&S 2000); no specimens were found. Reference populations were not checked beforehand.

Additional botanical surveys were performed at Madera Ranch on April 14 and 15 and August 6 and 7, 2009 (ICF J&S 2009). Reference populations were checked first. The survey area consisted of approximately 350 acres of swales to which recharge flows would be applied during the project's Phase 1. No federally-listed threatened or endangered plant species were found in the study area.

<u>Conservancy Fairy Shrimp</u>
Reconnaissance-level surveys were conducted by ICF biologists in 2000 (J&S 2005) for vernal pool crustaceans on Madera Ranch. Only a portion of the pools were sampled. No pools were found to contain Conservancy fairy shrimp.

On March 23, 2010, CDFG biologists sampled all pools on Madera Ranch plus one watering trough (CDFG 2010). Overall, the entire site was dry and only a few vernal pools had any water, despite the water year for 2009/2010 being average or slightly above average. Almost all of the wetted pools were along road embankments. Many of the vernal pools appeared to be better characterized as alkali playa. There were two locations with large amounts of standing water and no Conservancy fairy shrimp were found.

The Conservancy fairy shrimp may occur in any of the pools (37.5 total acres) on Madera Ranch. Several of the pools on Madera Ranch are within the size range of pools at Sandy Mush that were found to have Conservancy fairy shrimp, although the pools are at the lower end of the range that Helm (1998) found to be occupied by the species. Therefore, Conservancy fairy shrimp cannot be ruled out as occurring in the action area.

<u>Vernal Pool Fairy Shrimp</u>
Reconnaissance-level surveys were conducted by ICF biologists in 2000 (J&S 2005) for vernal pool crustaceans on Madera Ranch. Only a portion of the pools were sampled. Some pools were found to have vernal pool fairy shrimp.

On March 23, 2010, CDFG biologists sampled all pools on Madera Ranch plus one watering trough (CDFG 2010). Overall, the entire site was dry and only a few vernal pools had any water, despite the water year for 2009/2010 being average or slightly above average. Almost all of the wetted pools were along road embankments. Many of the vernal pools appeared to be better characterized as alkali playa. There were two locations with large amounts of standing water and no vernal pool fairy shrimp were found.

The vernal pool fairy shrimp may occur in any of the pools (37.5 total acres) on Madera Ranch.

Vernal Pool Tadpole Shrimp

Reconnaissance-level surveys were conducted by ICF biologists in 2000 (J&S 2005) for vernal pool crustaceans on Madera Ranch. Only a portion of the pools were sampled. No pools were found to contain vernal pool tadpole shrimp.

On March 23, 2010, CDFG biologists sampled all pools on Madera Ranch plus one watering trough (CDFG 2010). Overall, the entire site was dry and only a few vernal pools had any water, despite the water year for 2009/2010 being average or slightly above average. Almost all of the wetted pools were along road embankments. Many of the vernal pools appeared to be better characterized as alkali playa. There were two locations with large amounts of standing water and no vernal pool tadpole shrimp were found.

The vernal pool tadpole shrimp may occur in any of the pools (37.5 total acres) on Madera Ranch.

Factors Affecting Species Environment within the Action Area.

Little information is available that would describe the land uses that have affected listed species on the ranch although MID has reported that there have been periods of time when vegetation was tall and when rodenticide was used extensively on site (Urrutia, pers. comm.). Although the surrounding land has been converted to irrigated or dryland agriculture, most of Madera Ranch is open, grazed rangeland. Rangeland vegetation consists primarily of annual grassland. Two grassland plant communities (California annual grassland and alkali grassland) and two wetland plant communities (vernal pool and alkali rain pool) are present in the annual grassland. In addition, Great Valley iodine bush scrub occurs in the northern half of Section 7.

Freshwater marsh is present in portions of the channel of the Gravelly Ford Canal. Riparian woodland is present on the margins of a small pond in Section 28. Vineyards, orchards, and cropland are present in cultivated portions of the ranch. The ranch does have a number of constructed features that have resulted in habitat loss for native species including canals and roads. Information on activities on the ranch that are currently affecting listed species has not been presented to us. However, in a December 16, 2010 meeting the project proponent did indicate that much of the "swale system has been used historically when water is available, and that they are connected to the end of the MID system and carriage water and flood flows are directed into those swales currently."

EFFECTS OF THE PROPOSED ACTION ON LISTED SPECIES

Based on all available information, the Service believes the federally-listed species discussed in this biological opinion are reasonably certain to occur in the action area. While this same information also suggests the likelihood that numbers of some species may be low relative to other locations, the Service believes that each of the species discussed will be adversely affected from various components of the proposed action, from both direct and indirect effects of the action. Much of the discussion below about these anticipated effects is based on information provided in the BA for the proposed project.

Project Components Causing Direct and Indirect Adverse Effects to Species

The proposed action involves constructing 81,854 linear feet of delivery and recovery canals, and 79,680 linear feet of roadway (permanent loss) needed to deliver water to 550 acres of natural swales that will function as recharge basins, and installing five soil berms to direct recharge flows. Construction related to the expansion of the canal system and access road system will result in the loss of 131 acres of annual grasslands, alkali grassland, alkali rain pool, freshwater marsh, and cultivated lands. The proposed action also involves constructing (excavating) 323 acres of recharge basins in annual and alkali grasslands (permanent loss). The proposed action also involves the installation of 87,776 linear feet of recovery pipeline and well system which would result in temporary ground disturbance impacts to 323 acres of annual grasslands, alkali grassland, alkali rain pool, and cultivated lands. In addition, there will be 49 recovery wells installed initially affecting approximately 50 acres. However, the finished wells will be on 20 foot by 20 foot well pads surrounded by chain link fence. All components of the construction-related disturbance (*e.g.*, ground excavation, equipment noise, human presence) will have a direct effect on one or more of the federally listed species within the action area.

The proposed action also involves the flooding of 550 acres of natural swales, for use as groundwater recharge basins. Presently, these swales function naturally, becoming inundated with water only on an infrequent basis during the rainy season. The initial flooding of these areas outside of the typical wet season will also have direct effects on all species that are using this habitat at the time of flooding and are unable to avoid impact (*i.e.*, physically escape). The repeated and prolonged flooding of the swales will result in the soils around and between the swales changing in character, causing an estimated increase of 20-percent (110 acres) to the total acreage affected by the project.

As noted above, the construction component of the proposed action will result in the permanent loss or significant alteration of approximately 454 acres of annual and alkali grassland habitats and temporary effects to 323 acres of grassland habitats from installing the recovery wells and pipeline. Effects to species will occur directly as a result of the construction for this habitat loss, but will also have indirect effects on species in the habitats surrounding these permanent loss areas. Indirect effects, as defined by the Act, are those that are caused by the proposed action and are later in time, but are still reasonably certain to occur. Loss of this land effectively removes it from the landscape as habitat that is used by the listed species for essential behavioral patterns of breeding, feeding, or sheltering. Thus, species in the action area will be affected beyond the timeframe of project construction by effects such as loss of foraging opportunities and fewer sites for sheltering from predation.

In addition to the direct and indirect effects resulting from the loss of the 777 (454+323) acres, the Service also believes the use of the 660 acres of natural swales as recharge areas will effectively be a permanent loss of habitat for listed species in the action area. The BA for the proposed project describes the effect to these natural swales as "long-term degradation." However, as presently existing, these swales are inundated only on an infrequent basis during the rainy season each year. Under the proposed action, these swales will likely either be inundated for a significantly longer duration during the year or altered hydrologically such that their essential characteristics are permanently changed. While the swales will remain habitat, as opposed to some hardscaped infrastructure lands, it is unlikely that they will remain useful habitat for the listed species consulted on here.

This alteration of the natural hydrological regime is likely to change the vegetative character of these swales and, because the soils in the lands immediately adjacent to the swales are also highly permeable, it is assumed that a portion of water delivered to the swales will disperse laterally and similarly change the character of the landscape for some indeterminate distance beyond the current swale boundary. Reclamation has assumed that this lateral saturation is likely to amount to an increase of approximately 20-percent in the wetted area associated with flooding the swales. However, the actual distance that water will move laterally will depend on the depth, duration and frequency of the inundation events.

For some of the listed species in the action area, the Service believes it is reasonably certain that indirect adverse effects will occur from this lateral extension over time of the changing habitat characteristics anticipated from the flooding of the 550 acres of natural swales. As described in the BA, Reclamation has accounted for this potential lateral effect by adding a 20% upper limit increase of effect acreage in some habitat types for vegetation changes beyond the perimeter of water application. Based on this, Reclamation has assumed a total of 660 acres will be ultimately affected from flooding of the natural swales. Therefore, the total acreage from which we anticipate indirect effects to one or more species is at a minimum greater than the 1,437 (777 + 660) acres detailed above.

Project Components Causing Potential Direct and Indirect Beneficial Effects to Species

Among the environmental commitments provided in the BA is one for establishing a Grasslands Conservation easement. As described, this easement on portions of Madera Ranch would serve as mitigation for the loss of California annual grassland, alkali grassland, and Great valley iodine bush scrub. The amount of land placed under this easement is to be based on a formula presented in the BA, whereby land subjected to long-term degradation in the proposed project (*i.e.*, flooded natural swales) will be mitigated at a ratio of 2:1 (acres conserved:acres affected), and land subjected to permanent loss will be mitigated at a ratio of 3:1. The project proponent plans to implement a management plan on this site involving grazing management and species monitoring.

Protection and management of these lands may provide long-term benefits to listed species on the Madera Ranch. However, the BA also points out that the same type of habitat fragmentation and edge effects anticipated from construction of the project elsewhere on the ranch are likely to also be manifested on the mitigation lands. The reason this is likely to occur is because the proposed mitigation lands will separated by the flooded swale system in Area 3, the refurbished Gravelly Ford Canal will also provide a barrier, and the new Section 8 Canal northern extension will bisect Area 1. For these reasons, it is not possible to determine with certainty whether there will be a net benefit effect to listed species from this mitigation.

- **Fresno Kangaroo Rat and Blunt-Nosed Leopard Lizard**

Due to the fact that blunt-nosed leopard lizard is closely associated with kangaroo rats when co-occurring on the landscape, evidenced by the blunt-nosed leopard lizard's specific use of kangaroo rat burrows for essential components of its life cycle, impacts to their habitat will result in similar effects to both species. Implementation of the proposed project will result in the permanent loss of large amounts of habitat for these species, which may reduce or eliminate opportunities in the action area for both species to breed, feed, and shelter. More significant, however, is the fact that long-term inundation of the natural and human-made swales from project implementation is likely to alter many of the basic ecological characteristics of this site.

Long-term inundation of the swales will result in a new mosaic of habitats on site, including different plant species and different soil conditions. The plant species composition in and adjacent to the swales is likely to change because the wetter conditions in and around the swales will favor the growth of wetland species or upland species that are less drought-tolerant. This process has been observed on Madera Ranch, as swales with irrigation runoff discharged into them have experienced an increase in nonnative weedy plants.

Changing the ecology of the site from a xeric landscape, with only periodic inundation of shallow swale systems during the rainy season, to one with large expanses of long-term inundation is also likely to bring about significant changes in the composition of the site's fauna. Avian fauna will likely increase in diversity when the swales are wetted, with a subsequent increase in birds that would prey on both blunt-nosed leopard lizard and Fresno kangaroo rat. The presence of persistent water would also likely bring an increase in mammalian predators such as foxes and coyotes, both of which would place additional predation pressure on blunt-nosed leopard lizard and Fresno kangaroo rat.

This altered ecology is also likely to have some impact on the prey base for both blunt-nosed leopard lizard and Fresno kangaroo rat. An increase in nonnative weedy plants resulting from the swale inundation could potentially provide more forage for Fresno kangaroo rat while a change to more moist conditions and increased vegetative growth around the swales could potentially bring more insect prey for the blunt-nosed leopard lizard. However, there is not enough information available to conclude whether any changes to the prey base will be beneficial or deleterious.

Long-term flooding of the natural swale systems is likely to have an adverse effect on the overall reproductive output of both species. The swale systems present on the site are generally long and sinuous, spreading out through much of the grassland habitat. They can also be fairly wide, especially in relation to small, ground dwelling species like the blunt-nosed leopard lizard and Fresno kangaroo rat. Flooding these swales, and keeping them inundated for extended periods of time, will effectively create impassable barriers between any kangaroo rat or leopard lizard populations on either side of the swales. For the blunt-nosed leopard lizard, all grassland and iodine bush scrub habitat, with a 20 percent increase (for additional habitat affect beyond the area where water is to be applied in swales), was included for swale flooding. This figure was based on field observations made by MID and Reclamation for the existing flooded swales[2]. These barriers will end up reducing or eliminating reproductive opportunities for both species,

[2] Reclamation is aware of one study that also documents the apparent movement of water through rodent burrows, which was believed to contribute to gully formation (Longhurst 1957).

with a subsequent reduction in genetic exchange, and is likely to translate into a loss of individuals from their populations.

Related to the reproductive capacity for these species on site, the anticipated changes to the physical and ecological characteristics of the swale systems will likely result in an overall loss of burrowing habitat for all kangaroo species and, consequently, the blunt-nosed leopard lizard. Currently, many of the observed kangaroo rat burrow complexes on site are located on or near the edges of the uplands adjacent to the swales. These burrow complexes will have certain characteristics, such as humidity and soil conditions, that make them suitable as areas for kangaroo rat colonies. These characteristics in burrows near the existing swales that have not historically been wetted would almost certainly change once the long-term inundation effort begins, with the likelihood that kangaroo rats would then have to move farther back from the swale edges in an effort to find similarly suitable conditions for burrow construction in habitat that is not already occupied. While the kangaroo rats may or may not be successful in this effort, there will still likely be an overall loss of potential burrow habitat available for both Fresno kangaroo rat and blunt-nosed leopard lizard once swale conditions change.

In summary, the Service anticipates that both the Fresno kangaroo rat and blunt-nosed leopard lizard are present in the action area, and are likely to be adversely affected by implementation of the proposed project. We believe both species will be taken during the physical construction of the project, due to the direct ground disturbance components of the action (*e.g.*, excavation, grading, trenching), and during the initial flooding of the swale systems. Individuals of both species will be harassed, harmed, and / or killed by these actions. We also believe that both species will be taken beyond the timeframe of project construction as a result of the multiple indirect effects described above. Individuals will be harmed and/or killed by a variety of effects from the anticipated habitat changes, impacting their essential behavioral patterns of breeding, feeding, and sheltering.

Vernal Pool Fairy Shrimp, Vernal Pool Tadpole Shrimp, Conservancy Fairy Shrimp, Green's Tuctoria, Palmate Bracted Bird's Beak

For the palmate-bracted bird's beak, all grassland and iodine bush scrub to be flooded (plus 20 percent) was included as a conservative estimate of potential affected habitat. For the vernal pool species and for California tiger salamander breeding habitat, all vernal pool and alkali rain pools were included for each type of effect. We have analyzed effects to the vernal pool wetland species together, as they depend upon and occur in a common habitat type. In addition, site specific information, including surveys for these listed species were not presented to us that would enable a species by species analysis.

Surveys consistent with the Service approved protocol for vernal pool crustaceans were not conducted, and the action agency has assumed or confirmed presence of these vernal pool dependent species in suitable habitats present on the project site. We concur that, without surveys to demonstrate otherwise, it is reasonable to assume presence of these species based on the suitability of habitats and known occurrences of these species in the vicinity (<10 miles).

According to the biological assessment, adverse effects to these listed species could occur as a result of construction related activities (both permanent and temporary) and from the intermittent flooding of specific areas of the ranch. Effects to these species include loss of habitat necessary for breeding, feeding, or sheltering, direct mortality, injury, or harassment of individuals resulting from construction activities and human intrusion.

Effects related to seasonal flooding – Seasonal flooding of vernal pools and swales will result in changes in the hydrologic regime that could allow nonnative invasive wetland species to become established and could adversely change the structure and habitat quality for these species. The introduction of freshwater may alter soil pH or other soil chemistry, potentially affecting these listed species. Although periodic sheet flooding is believed to be necessary for germination of plants and the life cycle of crustaceans, permanent flooding and alteration of soil chemistry is likely to lead to habitat loss. Operation and maintenance of MID facilities could result in direct effects on vernal pool species.

Flooding swales on a seasonal basis could result in degradation of vernal pool habitat for vernal pools within the swales and major adverse effects on vernal pool species in these areas. Temporary rapid expansion of the existing pools from uncontrolled flows could move extant crustaceans and their eggs and/or seeds from plants to peripheral areas where they could be subject to increased mortality from desiccation and/or predation during subsequent rapid pool-size decrease as the waters percolate into the subsurface. Adding periodic flows to the drainages would increase the frequency and duration of inundation. Such changes may benefit vernal pool species, especially in vernal pools with relatively short inundation regimes. However, prolonging the inundation period in some pools could allow nonnative invasive wetland species to become established that could adversely change the structure and habitat quality of the pools. Flowing water may adversely affect vernal pools by scouring seeds, eggs and organic material from the pool bottom into nonbonding sections of the swales. Consequently, seasonal flooding of the swales could cause the long-term degradation of vernal pool habitat and associated direct mortality in some populations of the vernal pool crustaceans if they are present.

Effects related to construction of infrastructure - Excavating, grading, trenching, soil movement, soil compaction, and removal of vernal pools and swales and seasonal wetlands will result in direct adverse effects on vernal pool species. Trenching and soil movement could result in indirect adverse effects by altering suitable habitat, such as changing the hydrology of or increasing sedimentation in the pools.

In conclusion, the biological assessment indicates that up to 15.2 acres of vernal pools potentially suitable for Green's tuctoria, vernal pool fairy shrimp, tadpole shrimp, and Conservancy shrimp will be either directly (from construction) or indirectly (from changes in the timing or duration of flooding) effected by the proposed actions. In addition, up to 476 acres of habitat suitable for the life history requirements of the palmate-bracted bird's beak will be impacted by the proposed action.

- **San Joaquin Kit Fox**

The effects as described in the January 2011 biological assessment include a description of the direct and indirect effects that will occur as a result of the proposed action. Collisions with vehicle traffic associated with the construction and maintenance phases of the project could injure or kill kit foxes using the area. Activities associated with the construction phase of the project including, excavation, grading, trenching, soil movement, and soil compaction could result in direct effects on this species. San Joaquin kit fox could be trapped inside den burrows, or will avoid the activities and move to adjacent areas where they could be subject to increased exposure to predators and prey shortages. Additionally, noise and ground vibration from intermittent well operation may mask important natural sounds used by kit foxes to detect prey and avoid predators.

Operational effects, including vegetation changes resulting from seasonal inundation of swales, also have the potential to affect this species. For the San Joaquin kit fox, all grassland and iodine bush scrub habitat, with a 20 percent increase (for additional habitat affect beyond the area where water is to be applied in swales), was included for swale flooding. This figure was based on field observations made by MID and Reclamation for the existing flooded swales. These operational effects will reduce the amount of habitat available to the species to breed, feed and find shelter, to some extent. However, due to their mobility and home range size, these effects (either positive or negative) are difficult to predict. Vehicle traffic, soil movement, and compaction effects associated with maintenance may occur intermittently in small areas where repairs are needed and these effects will occur along the same corridor in which the facility was initially installed.

When construction is completed a total of 1,114 (454 infrastructure + 660 swales) acres of alkali grassland habitat and annual grassland habitat would be permanently affected. The extent of this effect on the species depends on the presence and abundance of the species in the construction area and the species' ability to persist in the area post-construction. The localized direct effects could be substantial if the species is not avoided.

Overall, there will be a net decrease in the amount of habitat available to this species to use for breeding, feeding and sheltering. According to the biological assessment 1,437 acres of grasslands/scrub will be permanently or temporarily/intermittently lost as a result of construction and operation of the project. This will result in increased fragmentation of habitat for this species.

- **California Tiger Salamander**

Surveys consistent with Service approved protocol were not conducted for this species, and Reclamation has assumed the presence of this species in suitable habitats present on the project site. We concur that, without surveys to demonstrate otherwise, it is reasonable to assume presence of this species based on the suitability of habitats and known occurrences of these species in the vicinity (<10 miles).

According to the biological assessment, adverse effects to these listed species could occur as a result of construction related activities (both permanent and temporary) and from the intermittent flooding of specific areas of the ranch. For the California tiger salamander, all grassland and iodine bush scrub habitat, with a 20 percent increase (for additional habitat affect beyond the area where water is to be applied in swales), was included for swale flooding. This number was based on field observations made by MID and Reclamation for the existing flooded swales. Effects to these species include loss of habitat necessary for breeding, feeding, or sheltering, direct mortality, injury, or harassment of individuals resulting from construction activities and human intrusion.

Potential for Construction-Related Mortality of California Tiger Salamander Construction and modification, including direct and indirect effects on naturally occurring vernal pools, alkali rain pools, wetlands in Gravelly Ford Canal, annual grassland, and alkali grassland could have adverse effects on California tiger salamander if this species is present on Madera Ranch. The California tiger salamander is federally listed as threatened. Vernal and alkali rain pools are potential breeding habitat for this species, and upland areas within 1.25 miles of a wetland are potential upland refugial habitat. Madera Ranch has suitable habitat for this species, and it is within the historical distribution range, but no evidence of California tiger salamanders was found during reconnaissance surveys conducted for amphibians while surveying for vernal pool crustaceans, or during systematic single-season surveys by CDFG in 2010. Nonetheless, the species has not been ruled out as occurring in the action area.

Effects related to construction of infrastructure - If the species is present, excavating, grading, trenching, soil movement, soil compaction, and removing vernal pools and adjacent nonbreeding habitat could result in direct effects on this species. Tiger salamanders could be trapped inside their estivation or shelter burrows, crushed by construction vehicles, or displaced to adjacent areas where they could be subject to increased exposure, food shortages, and predation. Grading, trenching, and soil movement could also alter the hydrology of the habitat and compact available animal burrows suitable for shelter and estivation, causing additional indirect adverse effects on the species.

If tiger salamanders are present, there would be an adverse effect on a species that is listed as threatened under the ESA and could substantially reduce the local distribution of sensitive biological resources occurring at Madera Ranch.

Potential for operation- and maintenance-related mortality of California tiger salamander - Operation and maintenance of MID facilities could result in direct effects on California tiger salamander if this species is found to occur in vernal pools that would be near these activities. Flooding natural swales on a seasonal basis could result in beneficial or adverse effects on this species. Expanded pool size and duration could benefit breeding tiger salamanders by increasing the area and time available for breeding. However, rapid pulsing of water input and percolation loss following the initiation of breeding could result in the movement of adults, larvae, and eggs to areas beyond the traditional boundaries of the vernal pool or swale areas and result in increased loss from desiccation and/or predation.

Other operational effects are also possible. As described in the Proposed Action section of Reclamation's Biological Assessment, if the swales pond water and mosquitoes become an issue with the Madera County Mosquito Abatement and Vector Control District, the abatement district may use mosquitofish to control mosquitoes. These fish could also prey on California tiger salamander larvae. However, the overall need for mosquitofish is expected to be low because water levels would fluctuate rapidly as water flows through the swales and generally would not persist after flows cease.

Furthermore, if swales are wet or moist year-round, they could become a dispersal corridor for bullfrogs. Bullfrogs could prey on California tiger salamander. However, swales are not expected to be wet year-round, and periodic drying of the swales would inhibit the establishment of bullfrogs in the interior of the property.

If California tiger salamanders are present, their distribution and abundance could be reduced at Madera Ranch as a result of constructing and operating the infrastructure associated with the WSEP.

MID has proposed providing 5,813 acres of compensation to off-set the effects to 1,437 acres of habitat for listed species that will result from construction and the long-term operation of the MID WSEP. The compensation acreage consists of two parcels totaling 2,357 acres that MID will manage to provide habitat for Fresno kangaroo rat, blunt-nosed leopard lizard, and San Joaquin kit fox. Included in this total is the parcel that will be used to create 7.0 acres vernal pool wetlands on suitable grassland habitat. The third block of land, totaling approximately 3,456 acres, connects the two compensation parcels and contains the swales that are to be flooded for groundwater recharge operations. There would continue to be grazing and habitat maintenance conducted between the swales to allow for habitat connectivity between the areas being managed for endangered species compensation.

MID will record a conservation easement on the two parcels of compensation lands and the lands dedicated to water banking with a secondary purpose of providing connecting corridors between the compensation lands. The easement and the endowment are to be held by an entity agreeable to the Service, CDFG, the Corps, and MID. The overall management of the conservation easement areas will be accomplished in accordance with the Mitigation and Management Plan agreed upon by the Service, Reclamation, CDFG, the Corps, and MID.

Cumulative Effects

Cumulative effects include the effects of future State, Tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. The Action Area consists of the recharge areas and recovery well network on Madera Ranch, the delivery canals and lift station network east of the ranch, water delivery service area of MID, potential water delivery to the Gravelly Ford Water District and the Chowchilla Water District, and to municipal and industrial participants in Madera County and the possible delivery of water for environmental use outside Madera County at the Mendota Pool Wildlife Area. At some time in the future, MID may begin to accept water to be stored in the bank from other CVP Contractors as part of a Transfer Action which will the subject of a stand-alone consultation pursuant to section 7 of the Act at that time. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Future development projects planned in the vicinity of the MID WSEP are expected to reduce available suitable habitat further; those projects have no certainty of being indirectly caused by the project, and as such, they are best considered as cumulative actions. These projects are:

- Rio Mesa Area Plan (e.g., Riverbend Ranch, River Ranch, Sumner Hill)

- Madera County General Plan (e.g., Rolling Hills Estates, River Ridge Estates, San Joaquin River Bluff Estates, Madera Ranches, Bonadelle Ranches, Gateway Village)
- Valley Children's Hospital/Gunner Ranch West Area Plan
- State Center Community College Plan
- Ball Ranch Specific Plan

Conclusion

The action is proposed to occur on lands specifically identified in our Recovery Plan for Upland Species of the San Joaquin Valley as important for protection and management for listed species recovery. The project site may contain one of the last known occurrences of Fresno kangaroo-rat and has the northern most occurrences of the blunt-nosed leopard lizard. Conserving all extant populations of the Fresno kangaroo-rat and protecting peripheral populations of the blunt-nosed leopard lizard is important for the recovery of these species (Leisca and Allendorf 1995, Nielson et al 2001, Redford et al). The project proponent has proposed to fully protect approximately 2,357 acres of habitat (containing approximately 10 acres of facilities) and protect an additional 3,456 acres of habitat (containing approximately 375 acres of facilities and wetted swales) within the action area, however the value of these habitats are diminished due to their fragmentation and the indirect effects of the proposed actions to the habitat conditions that provide for the life history requirements of the species. The project as proposed will result in the fragmentation, loss and/or degradation of 700 to 1,300 acres of habitat used for breeding feeding and sheltering of listed species including the endangered Fresno kangaroo-rat, endangered blunt-nosed leopard lizard, threatened California tiger salamander and the endangered San Joaquin kit fox. The project as proposed is expected to contribute to the continued decline of the species addressed in this biological opinion.

Critical habitat has been designated for the Fresno kangaroo rat, California red-legged frog, Conservancy fairy shrimp, vernal pool fairy shrimp, vernal pool tadpole shrimp, California tiger salamander, and Greene's tuctoria. However, no critical habitat units for these species are located in the action area; therefore, no critical habitat for these species will be affected.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described in this incidental take statement are non-discretionary. Reclamation must ensure that the applicant undertakes these measures or makes them binding conditions of any authorization provided to contractors for the exemption under 7(o)(2) to apply. If the applicant (1) fails to adhere to the terms and conditions of the incidental take statement, and/or (2) Reclamation fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

Activities related to constructing 81,854 feet of delivery infrastructure improvements to deliver water to 550 acres of natural swales that will function as recharge basins, installing five soil berms to direct recharge flows into the swales, excavating 323 acres of recharge basins, and constructing approximately 87,776 feet of delivery and recovery pipelines and installing a maximum of 49 wells and will result in permanent impacts to 454 acres of annual grasslands, alkali grassland, alkali rain pool, freshwater marsh, and cultivated lands, including 1.7 acres of vernal pool and alkali rain pool from flooding the swales, and approximately 1.6 acres of alkali rain pools that provides suitable habitat for blunt-nosed leopard lizard, Fresno kangaroo rat and San Joaquin kit fox. Construction related to the expansion of the canal system and installation of the recovery pipeline and well system would result in temporary impacts to an additional 323 acres of annual grasslands, alkali grassland, alkali rain pool, freshwater marsh, and cultivated lands.

Repeatedly flooding the 550 acres of natural swales that will function as recharge basins will result in the collapse of the burrow systems located within and immediately adjacent to them as the soil is saturated for extended periods affecting an additional 20 percent (110 acres) of the land surrounding the swales. This physical change will make these areas unsuitable as forage or refugia for blunt-nosed leopard lizard, and Fresno kangaroo rat. The destruction or alteration of approximately 15.2 acres of vernal pool and alkali rain pool areas from the flooding operation of the swales within 250 feet of them will result in the loss of habitat potentially used by vernal pool fairy shrimp, vernal pool tadpole shrimp, conservancy fairy shrimp, palmate-bracted bird's beak, and Greene's tuctoria, and California tiger salamander.

Effect of the Take

The Service anticipates that incidental take of blunt nosed leopard lizard, Fresno kangaroo rat, San Joaquin kit fox, California tiger salamander, vernal pool fairy shrimp, vernal pool tadpole shrimp, and Conservancy fairy shrimp will be difficult to detect or quantify for the following reasons: the activity patterns of these species makes the finding of a dead specimen unlikely, losses may be masked by annual fluctuations in numbers, and the species occurs in habitat that makes it difficult to detect. Due to the difficulty in quantifying the number of individuals of these species that will be taken as a result of the proposed action, the Service is quantifying take incidental to the project as the number of acres of habitat that will be affected as a result of the action.

Therefore, the Service estimates that the proposed action will result in the incidental take of all individuals of these species inhabiting 1,437 acres at the project site. Any incidental take is expected to be in the form of harm, harassment, injury, and mortality from habitat loss and modification, construction related disturbance, increased predation, reduced fitness, and by the construction and long-term operation of the MID WSEP. However, the Service is also quantifying take of listed vernal pool crustaceans based on the number of acres of seasonal wetland habitat providing suitable habitat for the species that will be affected as a result of the action. The Service estimates that the proposed project will result in direct and indirect loss of 15.2 acres of suitable habitat for these listed vernal pool species.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the effects of the proposed Madera Irrigation District Water Supply Enhancement Project on the San Joaquin kit fox, blunt-nosed leopard lizard, Fresno kangaroo rat, vernal pool fairy shrimp, vernal pool tadpole shrimp, Conservancy fairy shrimp, and California tiger salamander.

1. All Environmental Commitments as described in the Biological Assessment, and as restated here in the *Description of the Proposed Action* of this Biological Opinion, must be fully implemented and adhered to.
2. Land that is to be set aside as habitat compensation and managed for the primary purpose of benefitting those listed species impacted by the proposed project must be protected in perpetuity, and with the intent to provide optimum conditions for those species.
3. To ensure that the expected changes to ecological conditions resulting from swale inundation do not result in take of Fresno kangaroo rats and blunt-nosed leopard lizards beyond what is anticipated in this biological opinion, hydrological conditions must be maintained such that there is no more than a 20 percent increase in acreage of vegetative changes beyond the perimeter of water applications (footprint of swales and seasonal wetlands).
4. The periodicity of swale inundation over the duration of this project must be monitored and adjusted, if necessary, to ensure that the time interval between swale flooding events does not result in a biological "sink" for Fresno kangaroo rats and blunt-nosed leopard lizards, whereby individuals of these species that may re-colonize burrows in or immediately adjacent to swales during dry periods are then taken by subsequent flooding. These adjustments could include repeated and/or more frequent wetting if the water supply is available, varying the priority/rotation of wetted swales, scaling back swale operations consistent with overall banking operational objectives, or other measures agreed to by MID, Reclamation, the Service, and CDFG.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, Reclamation must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

1. To implement Reasonable and Prudent Measure #1, Reclamation shall ensure through conditions in its approval letter or any funding for the proposed project that Madera Irrigation District fully implements and adheres to the Environmental Commitments presented in the Biological Assessment and restated here in this Biological Opinion. These Environmental Commitments must be adhered to, regardless of species status under the California Endangered Species Act .

2. To implement Reasonable and Prudent Measure #2, Reclamation shall ensure through conditions in its approval letter for the proposed project the following Terms and Conditions:

   a) Reclamation shall ensure that Madera Irrigation District grants and records an appropriate, Service-approved Conservation Easement with a Service-approved Conservation Easement holder for the mitigation lands described in the Biological Assessment, prior to project implementation.

   b) Reclamation shall ensure that Madera Irrigation District incorporates by reference its Mitigation and Management Plan, developed for these mitigation lands, into said Conservation Easement.

   c) Reclamation shall ensure that Madera Irrigation District includes language in the Conservation Easement stating that the Mitigation and Management Plan created for this project is a living document, to be viewed and used as an adaptive management plan under the direction and approval of the Service, CDFG & Corps, with the goal of ensuring optimum habitat conditions for the species of concern.

   d) Reclamation shall ensure that Madera Irrigation District has in place prior to project implementation an adequate, Service-approved funding mechanism, such as a non-wasting endowment held by a Service-approved endowment holder to fund the long-term management activities on their mitigation lands.

3. To implement Reasonable and Prudent Measure #3, Reclamation shall ensure through conditions in its approval letter or any funding instrument for the proposed project that MID develops and implements an appropriate Service-approved hydrological study or studies, designed to monitor and report on conditions related to changing ecosystem characteristics in and adjacent to the swales used for water banking purposes. Such studies, and the information obtained from them, shall be used to inform Reclamation and MID of the degree and nature of habitat modification from current conditions, and whether take resulting from vegetative changes beyond the perimeter of water applications (i.e., greater than 20 percent) is exceeded. The information gathered from these studies shall be provided to the Service and CDFG on thirty-day cycles or within thirty days of conclusion of a study cycle.

4. To implement Reasonable and Prudent Measure #4, Reclamation shall ensure through conditions in its approval letter or any funding for the proposed project that Madera Irrigation District develop a Service-approved monitoring and reporting approach for the inundated swales and adjacent habitat sufficient to determine whether Fresno kangaroo rats and blunt-nosed leopard lizards re-colonize these areas during dry periods.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to implement recovery actions, to help implement recovery plans, to develop information, or otherwise further the purposes of the Act.

1) Conduct controlled research on the effects of activities associated with repeated flooding to the physiology and behavior of Fresno kangaroo rat and blunt-nosed leopard lizard.
2) Assess the effects of soil moisture on Fresno kangaroo rat and blunt-nosed leopard lizard by determining the extent to which these effects persist in time. This should include determining the amount of moisture in varying soil types or topographic features and the amount of time it takes for these affected soils to return to pre-flooding moisture levels.
3) Conduct a controlled study of kangaroo rats and blunt-nosed leopard lizard before and after flooding events using methods such as radio-telemetry and critter cameras to quantify changes in behavior, and home range.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, the Service requests notification of the implementation of any of these conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the proposed Madera Irrigation District Water Supply Enhancement Project in Madera County, California. As provided in 50 CFR § 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been maintained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

If you have any questions regarding this biological opinion please contact the Branch Chief of the San Joaquin Valley Branch at the letterhead address or at telephone (916) 414-6600.

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