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
81420-2007-F-1362-2

NOV 0 9 2010

Ms. Jane M. Hicks
Chief, Regulatory Branch
San Francisco District
U.S. Army Corps of Engineers
1455 Market Street
San Francisco, California 94103-1398

Subject: Biological Opinion on the Proposed Potrero Hills Landfill Phase II Expansion Project, Solano County, California (Corps File No. 26024N)

Dear Ms. Hicks:

This letter is in response to your September 20, 2007, request for consultation with the U.S. Fish and Wildlife Service (Service) on the Proposed Potrero Hills Landfill (PHLF) Phase II Expansion Project in Solano County, California. At issue are the potential effects of the proposed project on the central distinct population segment of the threatened California tiger salamander (*Ambystoma californiense*) (tiger salamander), endangered Conservancy fairy shrimp (*Branchinecta conservatio*) and its critical habitat, endangered vernal pool tadpole shrimp (*Lepidurus packardi*) and its critical habitat, threatened vernal pool fairy shrimp (*Branchinecta lynchi*) and its critical habitat, endangered Contra Costa goldfields (*Lasthenia conjugens*) and its critical habitat, endangered Solano grass (*Tuctoria mucronata*), threatened San Joaquin Valley Orcutt grass (*Orcuttia inaequalis*), threatened Colusa grass (*Neostapfia colusana*), threatened Delta green ground beetle (*Elaphrus viridis*), threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), and the endangered callippe silverspot butterfly (*Speyeria callippe callippe*).

According to the rare plant surveys done by LSA Associates, Inc. (LSA), Solano grass, San Joaquin Valley Orcutt grass, and Colusa grass were not found in the action area, but Contra Costa goldfields were found within the action area only on the Director's Guild Parcel. Based on these results, the Service concurs that the proposed project is not likely to adversely affect Solano grass, San Joaquin Valley Orcutt grass, and Colusa grass.

According to invertebrate surveys done by LSA, Conservancy fairy shrimp, vernal pool tadpole shrimp, and vernal pool fairy shrimp were found within the action area only on the Director's Guild Parcel.

According to tiger salamander surveys done by LSA, tiger salamanders have been found on the Phase II Expansion Area, Pond 5 Buffer Area, Southern Hills Parcel, and the Eastern Valley Parcel.

Surveys were also conducted for the Delta green ground beetle, elderberry longhorn beetle, and the callippe silverspot butterfly. The results of Delta green ground beetle surveys were negative. Although there are elderberry shrubs located within the action area, they will not be affected by the project and there were no exit holes present on them. Johnny jump-up (*Viola pedunculata*), the food plant for the callippe silverspot butterfly, was found on the Phase II Expansion Area and in the northwest corner of the Southern Hills Parcel. The results of surveys for callippe silverspot butterflies were negative. Therefore, the Service concurs that the proposed project is not likely to adversely affect the Delta green ground beetle, elderberry longhorn beetle, and the callippe silverspot butterfly.

Conservancy fairy shrimp and its critical habitat, vernal pool tadpole shrimp and its critical habitat, vernal pool fairy shrimp and its critical habitat, Contra Costa goldfields and its critical habitat, and tiger salamanders could be adversely affected by the proposed project. Therefore, this document represents the Service's biological opinion on the effects of the proposed project on the tiger salamander, Conservancy fairy shrimp and its critical habitat, vernal pool tadpole shrimp and its critical habitat, vernal pool fairy shrimp and its critical habitat, and Contra Costa goldfields and its critical habitat. This document has been prepared under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*) (Act).

This document is based on: (1) a letter dated August 23, 2006, with enclosures; (2) a letter dated July 13, 2007, and enclosures; (3) a rare plant survey results dated December 3, 2008; (4) a wet season vernal pool crustacean survey results for the 2006-2007 and 2007-2008 seasons; (5) a dry season vernal pool crustacean survey results for summer 2008; (6) the delta green ground beetle habitat assessment dated May 14, 2008; (7) presence-absence survey results for delta green ground beetles on Phase II, Director's Guild, and Southern Hills parcels, dated June 10, 2008; (8) burrow distribution results for the Phase II Expansion Parcel, dated April 24, 2008; (9) the tiger salamander survey results dated December 3, 2008; (10) the PHLF Phase II Expansion Revised Biological Assessment dated September 8, 2009; (11) other electronic mail and telephone conversations between LSA and ESP and the Service; and (12) other information available to the Service.

CONSULTATION HISTORY

August 23, 2006:	The Service received a request from Environmental Stewardship & Planning (ESP) for technical assistance and informal consultation on the PHLF Phase II Expansion, dated August 21, 2006, which included the Biological Assessment, dated August 18, 2006.
January 12, 2007:	The Service received a request from LSA to conduct a wet season listed vernal pool crustacean survey for the PHLF Expansion Project.

January 26, 2007:	The Service approved wet season listed vernal pool crustacean survey for the PHLF Expansion Project.
July 13, 2007:	The Service received a letter from the Corps requesting consultation on the Potrero Hills Landfill Expansion Project.
November 14, 2007:	The Service received a request from LSA to conduct a wet season listed vernal pool crustacean survey and California tiger salamander surveys at the PHLF Expansion Project site.
November 28, 2007:	The Service visited the PHLF Phase II Expansion site with the California Department of Fish and Game (CDFG).
December 21, 2007:	The Service received the Recirculated Draft Environmental Impact Report for the PHLF Expansion Project on a CD.
December 31, 2007:	The Service received the Biological Assessment, the Mitigation and Monitoring Plan, and the Grassland Management Plan for Mitigation Areas for the PHLF Phase II Expansion, Revised December 21, 2007, from ESP.
January 3, 2008:	The Service received the Response to the Scientific Panel Review Report PHLF Phase II Expansion, dated December 4, 2007, from LSA.
January 15, 2008:	The Service received the wet season vernal pool survey for listed crustaceans report from LSA.
February 6, 2008:	The Service received comments on the Recirculated Draft Environmental Impact Report for the PHLF Expansion Project from the San Francisco Bay Conservation and Development Commission (BCDC).
February 13, 2008:	The Service received comments on the Recirculated Draft Environmental Impact Report for the PHLF Expansion Project from the California Regional Water Quality Control Board.
February 15, 2008:	The Service visited the PHLF Phase II Expansion site with the BCDC.
February 25, 2008:	The Service received a request from LSA to conduct tiger salamander surveys of the PHLF and conservation parcels.
March 4, 2008:	The Service met with PHLF, ESP, LSA, CDFG, and BCDC.
March 6, 2008:	The Service approved tiger salamander surveys on PHLF and conservation parcels.

April 10, 2008:	The Service visited the PHLF Phase II Expansion site with the BCDC and CDFG.
April 25, 2008:	The Service received the small mammal burrow distribution map for PHLF from LSA.
May 13, 2008:	The Service received a request from LSA to conduct a dry season shrimp survey for the PHLF Expansion Project.
May 19, 2008:	The Service approved dry season shrimp surveys for the PHLF Expansion Project.
June 10, 2008:	The Service received the Recirculated Final Environmental Impact Report for the PHLF Expansion Project from ESP.
June 24, 2008:	The Service received a letter from PHLF explaining the proposed criteria for creating a linkage between occupied California tiger salamander habitat and created conservation habitat.
October 30, 2008:	The Service received the 2007-2008 Wet Season Vernal Pool Crustacean Surveys of the PHLF Study Site dated October 15, 2008, from LSA.
November 4, 2008:	The Service received the 2008 Dry Season Vernal Pool Crustacean Surveys PHLF Expansion Area dated November 4, 2008, from LSA.
November 12, 2008:	The Service received the PHLF Phase II Expansion Revised Biological Assessment dated October 31, 2008 and the Grassland Management Plan for Mitigation Areas dated October 29, 2008, from ESP.
November 14, 2008:	The Service received the PHLF Phase II Expansion Revised Mitigation and Monitoring Plan dated November 12, 2008, from ESP.
December 3, 2008:	The Service received the results of the California Tiger Salamander Larvae Survey at the PHLF Site, March –May 2008 and the 2008 Special-Status Plants Survey Result for the Potrero Hills Landfill Phase II Expansion from LSA.
January 27, 2009:	The Service received a letter from the PHLF explaining the divestiture status.
April 6, 2009:	The Service received the PHLF Phase II Expansion Wetland Mitigation Plan dated March 11, 2009, and a Memorandum containing additional information and clarification, which included a Memo from LSA regarding the California Tiger Salamander Salvage Plan.

June 18, 2009:	The Service received the Results of Surveys for California Tiger Salamander Larvae at the PHLF Site, April-May 2009, dated June 16, 2009, from LSA.
September 11, 2009:	The Service received the PHLF Phase II Expansion Revised Biological Assessment and Revised Mitigation and Monitoring Plan, dated September 8, 2009, from ESP.
October 22, 2009:	The Service received the draft description and designs for a proposed overlook from BCDC.
December 10, 2009:	The Service received the a comment letter on the PHLF Phase II Expansion project 401 Water Quality Certification application from the California Regional Water Quality Control Board.
January 27, 2010:	The Service received the memorandum Documentation of Observation of *Branchinecta lynchi* at Director's Guild Parcel (parcel 46-130-170), Potrero Hills Landfill Mitigation Site, Solano County (Permit #TE-797234-7) from LSA and the Revised PHLF Grassland Management Plan for the Mitigation Areas, dated September 9, 2009, from ESP.
January 28, 2010:	The Service received information about the potential Southern Hills Trail.
February 3, 2010:	The Service received revised draft drawings for the Solano Garbage Company Overlook.
February 5, 2010:	The Service received the revised California tiger salamander salvage plan and a Botanical Resource Assessment of the Solano Garbage Company Landfill Site from LSA.
February 24, 2010	The Service received the Phase II Expansion Habitat Assessment for the Delta Green Ground Beetle, dated May 14, 2008, the Presence-Absence Survey for Delta Green Ground Beetle on the Director's Guild, Phase II Expansion, and the Southern Hills Parcel, dated June 10, 2008, and the Delta Green Ground Beetle Survey of the Director's Guild property, dated May 3, 2004, from ESP.
July 19, 2010	The Service received the 4th Revision of the Mitigation and Monitoring Plan, dated July 15, 2010, from ESP.
August 13, 2010	The Service received a receipt for the PHLF's purchase of 1.9 acres created seasonal wetlands credits, 1.0 acre created seasonal ponds credits, 1.1 acres preserved seasonal ponds credits, 1.0 acre preserved/enhanced stream channel credits and their long-term management and monitoring and an endowment from Wetland Resources LLC.

August 31, 2010 The Service received the 4th Update of the Memorandum- Salvaging California Tiger Salamanders at the Potrero Hills Landfill Phase II Expansion Site, Solano County from ESP.

BIOLOGICAL OPINION

Project Description

Potrero Hills Landfill, Inc. is proposing to expand the existing Potrero Hills Landfill, a municipal solid waste landfill and resource recovery center located near Suisun City in Solano County, California. The landfill expansion will encompass 165.16 acres of land and result in the conversion of the habitat from primarily non-native grassland to active landfill. In addition, aquatic habitats on the expansion site will be affected by the landfill expansion, including loss of approximately 1.86 acres of Clean Water Act, Section 404 jurisdictional wetlands and 0.61 acre of pond habitat.

As a municipal solid waste landfill, Potrero Hills Landfill accepts residual nonhazardous wastes for burial, as well as acting as a materials processing center where resource recovery activities are conducted and materials are diverted from landfilling through composting, wood recycling, concrete and asphalt rubble crushing and screening, metal salvage recovery, and other recycling services. The existing (and expanded landfill) has a service area encompassing the Bay Area, Central Valley, Sierra foothills and California North Coast within an approximately 150-mile radius.

The currently permitted landfill (referred to as the Phase I landfill) is on a 320-acre parcel. The active landfill module, three separate recycling areas, soil stockpiles, roads, other infrastructure, and an active sandstone quarry make up the operation areas of the site.

The proposed project entails the Phase II expansion of the Potrero Hills Landfill. The project will increase the capacity of the landfill from its currently authorized 21.5 million cubic yards to approximately 83 million cubic yards, and will extend the life of the landfill.

The currently permitted Phase I landfill commenced operations on the 320-acre parcel in 1986. The Phase 1 operation consists of 21 cells within which non-hazardous wastes are disposed. The operation also includes various landfill-associated facilities, including a sandstone quarry, administrative and service buildings, truck scales, public unloading and recyclables handling area, wood waste and composting processing facility, concrete crushing facility, fueling facilities and washing facilities.

The proposed Phase II project will add 11 new cells to the existing landfill. Under the proposed project plans, the capacity of each cell will be substantially greater than under Phase I because each cell will have a higher final elevation (increasing from the currently permitted 220 feet mean sea level (MSL) maximum elevation in a cell to a maximum of 345 feet MSL), allowing for a greater volume.

The project components consist of the following elements:

Extending the Landfill Horizontally

The Phase II project will extend the landfill onto an adjacent parcel of land, expanding the landfill horizontally for increased landfill life. The Phase II landfill footprint will be approximately 167.63 acres and will be entirely contained within the Potrero Hills Valley. Cell construction will initially progress along the northern edge of the Phase II area, with cells along the southern landfill boundary being constructed after about 2015. The final cells to be constructed in the Phase II Parcel will be in the southeast corner. The final area of the Phase I and II landfill to be constructed will be in the northwest corner of the Phase I Parcel.

Increase the Existing Permitted Landfill Height

The Phase II project includes a vertical expansion of the height of the landfill to an elevation of 345 feet MSL. Phase II also includes adding additional wastes on top of Phase I landfill. A portion of the top of the landfill will be viewable from the north; active landfill zones will be operated behind a visibility barrier so they will be out of sight from off site. The Phase II project would extend the Phase I slopes eastward to match up with the westernmost landfill contours of the Phase II area.

Relocation of Spring Branch Creek Drainage

Relocating the southern surface water drainage network (Spring Branch Creek and its tributaries) along the south side of the Phase II landfill will allow greater buttressing of the southern edge of the landfill and achieve vertical capacity expansion. No reduction of surface water-carrying capacity in channels and retention basins will occur. Two separate drainage systems will be constructed in the landfill to prevent the landfill from flooding and to divert runoff from the southern portion of the landfill off the cap. The drainage system will be constructed over the life of the proposed landfill (35 years), with additional sections being installed as the cells are built along the landfill southern boundary. The first of the drainage systems will carry water from the eastern Potrero Hills Valley west around the landfill. This drainage system will consist of a pipeline approximately 5,500 feet long that will pass under the soil buttress area along the southern border of the Phase I landfill area and Phase II expansion area. The downstream end of the pipeline will be located in the center of the Phase I landfill. The ultimate eastern end of the pipeline will be near the southeast corner of the Phase II area. The drainage feature will be designed to handle the 1,000-year storm to protect the landfill from flooding. Along its length, the pipeline will be bedded in native soil and overtopped entirely with soil materials. The pipeline will be constructed of pre-cast sections or of concrete poured in place with the segments being built in increments of approximately 200-600 feet every 3-5 years. The second system will be a surface channel to transport runoff from the southern portion of the landfill. Once the pipeline is constructed beneath the buttress, drainage runoff from the southern portion of the landfill will drain to a surface channel constructed on top of the buttress area. The surface channel will be protected from scouring with erosion control fabric. Each rise of the buttress area constructed as the adjacent zone of the landfill is built to higher elevations will contain a similarly constructed channel. A permanent drainage channel, with a long-term, stable channel lining will be constructed on top of the buttress when the final landfill cap is installed. The Phase I alignment was authorized in 1988 and 1995 pursuant to the provisions of Section 404 of the Clean Water Act, (33 U.S.C. 1344) and Section 10 of the Rivers and Harbors Act (33 U.S.C. 403).

Silt Control Basins

Sediment control berms and collection basins are placed down slope of fill areas. Periodically, during late summer, the silt accumulated in the basins is removed. Most of these basins on the west and south sides of the landfill are semi-permanent since they will be maintained adjacent to soil stockpiles or down slope from the recycling areas. To control the runoff from the east side of the landfill where the landfill construction will continue, a temporary rainwater storage pond is excavated in an adjacent eastward future landfill cell to be used as an interim east siltation control basin. The east basin will be moved eastward to a similar configuration as each new landfill cell is constructed to the east. This east basin seasonally is equipped with a diesel-operated pump during the wet weather season to allow the ponded water to be pumped into the drainage channel located at the south edge of the landfill. The section of channel where the pump discharge will occur will be appropriately lined to prevent scouring of the channel. When the east basin is to be relocated, the ponded water will be removed, and the silt and walls of the basin will be excavated as part of the cell construction.

Pipeline and Trough System on the Southern Hills

The Phase II site design incorporates the south slope buttress. The ephemeral storm flow runoff will be passed along the south edge of the landfill; a multi-barreled culvert will convey the water from the southeast corner of Phase II area to a point south of cell 6. This culvert will not be overlain with wastes, but will be built in stages, with the buttress soil fill built in steps to the elevations that correspond with the construction of the landfill lifts in this area. The culvert design meets Class II site standards and will pass a 1000-year storm flow of 765 cfs. As the buttress fill is formed, an east-west surface drainage channel will be formed on the top surface of the buttress to receive the drainage from the landfill surface down drains, and convey it to either the entrance and discharge ends of the culvert. The Grazing Management Plan (GMP) proposes a 7,005 foot long pipeline extending along the ridge of the Southern Hills to deliver water from an irrigation system on the Proposed Phase II Landfill Expansion area to a series of three or four troughs installed on concrete pads (to avoid trampling of saturated soils) in the Southern Hills Grazing Unit. Although this livestock water system has not yet been designed, it could require that the water be lifted about 180 feet to the top of the ridge by a small solar or electric pump to a tank in the northwest corner of the unit. The maximum size would be a 2,600-gallon round plastic tank 96 inches in diameter. It would be supplied by a suction pump at the edge of the Landfill Expansion area. The tank would then gravity feed water downhill in a pipeline that would consist of a maximum of 2-inch diameter plastic pipe that would be buried just deep and wide enough to cover using a small trencher. The troughs would be a maximum of 300-gallon capacity, about 7-feet long and 3-feet wide with water flow adjusted with a float valve. Following installation of the pipeline, the trench would be backfilled and allowed to revegetate naturally.

Wetland Fencing

The GMP proposes that two separate wetland pastures be created by enclosing them with approximately 3,775 feet of "wildlife-friendly" four-strand barbed wire fencing 42-inches high with an 18-inch gap between the ground and the lowest strand. As stated in the GMP, gates would be installed in these fences so that: "Livestock will be allowed to graze these wetland pastures for short periods ("pulse" grazing) based on observations and recommendations by the Resource Manager to allow for thatch removal and wetland vegetation management, with the wetlands protected during the rest of the year to allow for wetland enhancement. This will also allow for protection from grazing long enough for native woody vegetation to be planted and established in the wetland/riparian pastures." The exact timing and duration of pulse grazing in the wetland pastures would be based on frequent observations by the Resource Manager to determine when the livestock should be removed and the gates closed based on the level and extent of defoliation.

Supplemental Feeding Areas

The GMP purposely does not specify locations of supplemental feeding areas except to state that at the direction of the Resource Manager locations should be moved frequently and placed away from water to avoid overuse of any one area. The exact locations would be informed by grazing use pattern maps to place the supplements in previously underused areas. The GMP specifies that supplements should be placed at least 1,000 feet from water when possible, and moved when grazing use around the supplement location approaches target levels.

Operating 24 Hours per Day

The Phase II project would extend the current 20-hour per day operation to a 24-hour operation Monday through Friday and a 20-hour operation Saturday and Sunday.

Gas Flare

The landfill gas not otherwise productively converted into an energy product (e.g. electricity or gas for an off-site user) is combusted in the landfill gas flare. This flare is located approximately 400 feet south of the Self-haul Unloading Facility. The first flare is approaching capacity due to the continued landfill operation, and a second flare unit will be installed. Eventually, if the landfill gas is not utilized as an energy resource a third flare may be needed. That flare might be located elsewhere on-site to process landfill gas extracted from landfilled materials in the eastern portion of the Phase I and Phase II landfill. The flare is a cylindrical tower approximately 20 feet high; the flame is contained out of sight within the barrel of the tower. No audible alarms are installed. An automatic telephone callout system is employed to notify key PHLF personnel to respond to notices made during an unanticipated system operation change. All existing and future flares will have Nixalite or another Service and CDFG-approved perching prevention device applied to the top.

Adding Biosolids to the Composting Operation

The Phase II project will add biosolids to the composting operation as an additional material that can be composted. Additional food wastes also will be composted. The amount of these additional materials could total to 100 tons per day averaged over a 7-day period (TPD7). Appropriate operation techniques and procedures will be used to control dust and odors.

Install a Truck/Container Washing Facility

Construct a concrete-lined drive-through unit to reduce mud tracked out on the access road and to clean residues from hauling vehicles. The proposed location is on the western edge of the Phase I landfill next to the existing equipment maintenance facility.

Revise Restrictions on the Night Lighting (Number of Lights)

The Phase II Project change was authorized in the 2005 Use Permit approval and the 2006 Solid Waste Facility Permit revisions. A small number of lights will be used in a manner that avoids off-site reflection and glare. Portable construction lighting units would be stationed at the active face of the landfill. The lighting units are equipped with flood lamps attached to poles that can position the lamps from 8 to 15-feet above the ground level. The area lighted is generally a pattern extending forward of the lights to a distance of about 300 feet, and laterally the lit-up area extends out at an angle of about 60 degrees to each side of the lighting unit for a distance of about 200 feet. The lighting units will be placed so as to not create light and glare impacts to neighboring or distant locations, nor create a glare visibility hazard to the transfer vehicle drivers entering and exiting from the active landfill area. A maximum of seven construction light plants will be used at the site.

Upsizing Existing Off-Site PG&E Power Lines

The increased capacity of gas-fueled power generation equipment will require upsizing the existing off-site PG&E power lines. The existing line is not of sufficient voltage or current-carrying capacity to transmit the expected amount of electrical power that will be created from the conversion of landfill gas (up to 10 megawatts). This will require a linear extension of existing transmission lines approximately 6,000 feet, from the project boundary to the current developed area. This powerline extension would require no more than 22 power poles. The installation of each power pole would require a temporary disturbance area of 5 feet by 5 feet and a power pole footprint of 2 feet ^{2}.

Landfill Gas-to-Energy Facility

The size of this facility is anticipated to be up to 10 megawatts. The location of the landfill gas-to-energy facility will be completely within the footprint of the Phase I landfill area, near the current flare station. This component would also include new power line installations.

Water Supply Well and Conveyance Pipeline System

Four water storage tanks and associated conveyance systems would be constructed to utilize the existing north water well. The water tanks are to be installed on the Griffith Ranch Parcel, immediately north of the dividing line between Phase I and Phase II. The construction of the tanks includes building a 10-foot high sloped earthen berm to screen the tanks from the west, north, and east. The disturbed area during construction will be a total of 0.6 acre. Following construction completion, the earthen berm will be grassed (an area of about 0.5 acre), and only the tanks and the gravel apron surrounding the tanks will remain as nonvegetated area. That total non-vegetated area will be 0.1 acre.

New Sedimentation Basin

A temporary silt control basin is proposed down-gradient from the east-most active landfill cell area.

Landfill Buttress and Perimeter Berm

A perimeter berm and buttress fill-also referred to as a "shingle fill" along the southern edge of the landfill will be constructed of on-site soil material and will be phased-in during the Phase II cell development. The buttress fill is designed to improve the stability of the landfill slopes and increase landfill capacity. The perimeter berm is designed as a containment structure for leachate generated in the landfill cells and for anchoring the baseliner. The perimeter access road and drainage corridor will overlie the perimeter berm and buttress fill. The base of the pipeline that will pass the storm flow water past the south edge of the landfill will be in an excavated trench; the base of the excavation and porous material backfill would be lower than the base excavations for the clay landfill liner by about 5 feet along the entire southern edge of the landfill; thus it will also serve as a groundwater drain along the south side of the landfill. The pipeline will be outside the Phase II landfill expansion footprint. As the southern buttress is being constructed in lifts to match the height extension of the landfill lifts, several temporary sedimentation control basins will be installed on top of the buttress area to receive the runoff from the adjacent landfill slopes. The basins may discharge into drop inlets connected to the drainage pipeline below the buttress, or flow along the surface of the buttress and join the drainage downstream. When the final elevation of the buttress is reached, the permanent drainage will be provided, and the designated flow channels will be constructed covered with erosion resistant vegetation.

Griffith Ranch Road

The road is to continue to serve as a maintenance access road. Little travel occurs on this road. The primary use is for litter pickup. The grazing contractor that grazes cattle on the Phase II area, Eastern Valley and the Southern Hills uses the road for access to deliver the cattle, to monitor them, and later to remove them from the fields. Over time the road will be graveled to reduce the wet-weather maintenance needs.

Bird Abatement Services

PHLF currently contracts with Wingmaster Falconry, Inc. of Turlock, California to provide bird abatement services at the landfill. PHLF will continue to use Wingmaster or a similarly qualified firm for this service in the future. Wingmaster provides bird abatement services seasonally from September to mid-April. Wingmaster currently operates at the landfill eight to 10 hours a day, five days a week. Wingmaster uses birds, dogs, balloons, kites, pyrotechnics, and other non-lethal techniques to remove gulls from the landfill and to discourage gulls from settling at the landfill. The falcons used by Wingmaster are under complete control of their handlers at all times. The falcons never actually pursue gulls as prey. Rather, the falcons fly in pursuit of lures controlled by their handlers. The flight of the falcons is interpreted as aggressive behavior by the gulls, which then leave the area. Bird abatement activities at the landfill are coordinated with similar activities at Travis Air Force Base to ensure that the gulls avoid flight paths used by the Base. In addition to keeping flight paths clear, gull management also protects smaller bird species from predation by gulls and limits the nuisance caused at the landfill by large numbers of gulls.

Conservation Parcels

Six parcels located immediately adjacent to the Phase II Expansion Area (i.e., Southern Hills Parcel, Pond 5 Buffer of Phase II Parcel, the Director's Guild, the Griffith Ranch (excluding the southwest corner of the site, west of the existing access road that will be retained for secondary access by PHLF), the Eastern Valley Parcel, and the Eastern Hills Parcel) will be preserved as conservation areas. Preservation and management of the conservation parcels for the benefit of listed wildlife and plants also will benefit common plant and animal species that will be impacted by the Phase II expansion and that rely on grassland and wetland habitats in the vicinity.

Parcels to be preserved include the 428.7-acre Southern Hills Parcel, the 41.23-acre Pond 5 Buffer Area on the Phase II expansion Parcel, the 160-acre Eastern Valley Parcel, the 137.39-acre Eastern Hills Parcel, the 83.8-acre Director's Guild Parcel, and the 112.16-acre portion of the Griffith Ranch Parcel. All six parcels are currently owned by PHLF. Conserving these parcels will preserve and enhance seasonal wetlands and drainages on the Southern Hills, Pond 5 Buffer Area, Eastern Valley, Eastern Hills, and Griffith Ranch Parcels and unique vernal pools and seasonal wetlands on the Director's Guild Parcel. In addition, restoration and management of the Southern Hills, Pond 5 Buffer Area, Eastern Valley, Eastern Hills, and Griffith Ranch Parcels will protect the California tiger salamander and its upland and aquatic habitat, and habitat for common grassland species that inhabit the Potrero Hill area. The Director's Guild Parcel will protect listed vernal pool crustaceans and Contra Costa goldfields habitat. Further descriptions of the six conservation parcels are included in the 4th Revision of the Mitigation and Monitoring Plan (MMP) July 15, 2010, Potrero Hills Landfill Phase II Expansion, Solano County, California (LSA and ESP, 2009a). A Service and CDFG-approved conservation easement and endowment will be placed on these parcels, establishing these areas as plant and wildlife habitat in perpetuity. A Service and CDFG-approved entity will hold the conservation easements and will be responsible for the long-term management of these parcels.

Grazing Plan

Grazing on the conservation parcels will be conducted according to the terms of the *Potrero Hills Landfill Grassland Management Plan for Mitigation Areas: Southern Hills, Eastern Valley, Griffith Ranch, and Director's Guild Areas* (LSA and ESP, 2009b).

Livestock grazing and other management activities will be used on the conservation parcels to achieve the following goals: 1) optimizing biodiversity and habitat values for California tiger salamanders, burrowing owl, other special-status species, and common grassland species; 2) to ensure that management actions do not have adverse effects on other species and their habitats; and 3) to reduce wildfire hazards. The following specific objectives will be achieved to realize these general goals.

1. Use livestock grazing as a resource management tool to maintain and enhance biodiversity.

2. Eliminate or minimize impacts associated with unrestricted year-long use by cattle.

3. Use cattle grazing as a tool to help control invasive non-native plant species.

4. Use goat grazing and/or non-grazing treatments such as burning, mowing, herbicide use, biological controls (insects) and seeding with natives to help achieve biodiversity goals.

Trail Easement

PHLF will place a trail easement on the existing roads on the Southern Hills Parcel, so that in the future that they may be linked in a trail system from Grizzly Island Road. At the current time, there are no plans for such a trail system, but BCDC would like an easement secured in the event that this might happen in the future. The easement would utilize the existing road network. All the roads included in the easement area were developed by ranchers over 50 years ago, either by clear cut and leveling, placing culverts over drainages, or clear track of the road.

Any future BCDC project that would provide public access to the PHLF Conservation Properties would: 1) require consultation with the Service and CDFG, 2) be required to restrict access seasonally, to protect listed species, 3) be required to have access supervised by a docent or naturalist, and 4) be required to have fencing or something similar installed to prevent after hours access to the conservation parcels.

Solano Garbage Company Overlook

An overlook is proposed on top of the closed Solano Garbage Company for public viewing of Suisun Marsh. Per the requirements of the landfill closure plan, the site does not allow for the ponding of water and is covered by ruderal grasses. Any slumping of soil or cap fractures will be quickly repaired. The proposed overlook will include a 0.12 acre parking area, a 2,371 ft X 4 foot stair trail, a 1,592 foot X 6 foot trail, a 577 $foot^2$ viewing area, and a 345 $foot^2$ summit view area. Protocol-level plant surveys will be completed on the overlook site and sent to the Service for review prior to any construction of the interpretive area.

Conservation Measures

Potrero Hills Landfill, Inc. proposes the following measures be implemented during all project-related construction activities to minimize impacts on native plant and animal species, including listed species:

1. If any hazardous material is discharged during the construction period, the discharge will promptly be controlled, cleaned up, and properly disposed of off-site. Hazardous materials that are most likely to be used in construction areas include fuels (e.g., gasoline and diesel), lubricants, and solvents.

2. All construction equipment will use identified staging areas and access roads located in upland areas. Vehicular access to the construction areas will be primarily on existing roads or within the construction footprint.

3. All personnel and equipment will be required to stay within designated construction areas, including construction areas for off-site features, e.g., new utility lines and slope stabilization measures.

4. Refueling areas for equipment will be located at upland sites outside of wetlands. No intentional damage to vegetation will be permitted outside the designated construction areas, and no fires will be permitted in any construction area.

5. Construction workers will be permitted in the construction areas only to perform job-related tasks, and will not be allowed to enter sensitive areas that have been fenced or staked, unless they are installing exclusionary fencing, in which case they will work at the edge of and avoid entering the sensitive area. Sensitive areas include preserved wetlands, drainages, and other preserved open-space areas.

6. Food items may attract wildlife onto the construction site, which would expose them to construction-related hazards. The construction site will be maintained in a clean condition. All trash (e.g., food scraps, cans, bottles, containers, wrappers, cigarette butts, and other discarded items) will be placed in closed containers and properly disposed of with-in the landfill disposal area.

7. After construction is completed, a final cleanup will include removal of all stakes, temporary fencing, flagging, and other refuse generated by construction. No naturally occurring plant material (e.g., shrubs) will be removed or disturbed in the cleanup process.

8. PHLF will implement the Mitigation and Monitoring Plan, PHLF Phase II Expansion, Solano County, California, 4th Revision (July 15, 2010), which includes: (1) preservation of 863.14 acres of California tiger salamander upland habitat; (2) preservation of 20.74 acres of upland grassland habitat that is not California tiger salamander habitat (upland grasslands on the Director's Guild Parcel); (3) preservation of 4.73 acres of pond habitat (breeding habitat for California tiger salamander); (4) creation/restoration of 1.78 acres of pond habitat (breeding habitat for California tiger salamander); (5) preservation of 65.12 acres of seasonal wetlands; (6) creation of 4.49 acres of seasonal wetlands (7) preservation and enhancement of 1.48 acre of channel ; and (8) creation of 1.80 acres of swale/channel. See Table I.

9. PHLF will implement the Grassland Management Plan for Mitigation Areas, 3rd Revision (September 8, 2009).

10. PHLF will protect in perpetuity 963.28 acres through the acquisition of habitat approved by the Service/CDFG and as outlined in the Project Description of this Biological Opinion. The mitigation lands will have a conservation easement or other appropriate encumbrance, management plan, and endowment to manage the habitat in perpetuity; all of which shall be reviewed and approved by the Service/CDFG, and completed within 18 calendar months of ground-disturbing activities. The draft conservation easement language will be submitted to and approved by the Service and CDFG prior to ground-disturbing activities. A draft management plan and Property Analysis Record (PAR) or PAR-equivalent analysis will be submitted to the Service and CDFG within 6 months of ground-disturbing activities. The conservation easement will name the Service/CDFG as third-party beneficiaries and will be held by an entity qualified to hold conservation easements subject to Service/CDFG approval or will be held by CDFG. An endowment to manage the land and monitor the conservation easement will be provided. The endowment will be held by a Service/CDFG-approved entity or will be held by CDFG in an amount approved by the Service/CDFG. The management plan will include, but is not limited to: a description of existing habitats and planned habitat creation, restoration and/or enhancement; monitoring criteria for California tiger salamander; an integrated pest management and monitoring plan to control invasive species; habitat creation, restoration and/or enhancement success criteria; adaptive management strategies if

success criteria are not met or to incorporate new scientific data, description of funding priorities and administrative details in case of land transfer or change of land manager.

11. If the conservation easement is not recorded or endowments not funded prior to project impacts, funding assurances for land acquisition, land management endowment, and conservation easement monitoring endowment (if any) will be secured by an Irrevocable Letter of Credit (LOC) or other mechanism approved by Service and CDFG and with language reviewed and approved by Service and CDFG, and the issued LOC shall be provided prior to ground-disturbing activities. Potrero Hills Landfill will be responsible for all actual costs for land acquisition and endowments. The funding assurance provided for land acquisition shall be based on the appraised value for the proposed property. The funding assurance provided for the endowment shall be based on an estimate of management and monitoring costs based upon a draft management plan prepared by project proponent and approved by the Service and CDFG.

12. Conduct Mandatory Contractor/Worker Awareness Training for Construction Personnel: The Service and CDFG-approved biologist will conduct mandatory contractor/worker awareness training for construction personnel. The awareness training will be provided to all construction personnel to brief them on the need to avoid effects to listed species and their habitat and the potential for any special status wildlife species to occur on the site. If new construction personnel are added to the project, the contractor will ensure that the personnel receive the mandatory training before starting work. A representative will be appointed during the employee education program to be the contact for any employee or contractor who might inadvertently kill or injure a listed species or who finds a dead, injured, or entrapped individual. The representative's name and telephone number will be provided to the Service and CDFG prior to the initiation of ground disturbance.

13. A Service and CDFG-approved biological monitor will be present at each work area to monitor for California tiger salamanders in the work area at the beginning of each workday (before work begins each day) during construction activities.

14. All construction equipment will use the identified staging areas and access roads located in upland areas. Vehicular access to the construction areas will be primarily on existing roads or within the construction footprint.

15. All equipment shall be inspected for oil and fuel leaks every day prior to use. Equipment with oil or fuel leaks shall not be used within 100 feet of wetlands.

16. A hazardous spill plan will be developed prior to construction of each action. The plan will describe what actions will be taken in the event of a spill. The plan will also incorporate preventative measures to be implemented, such as vehicle and equipment staging, cleaning, maintenance, and refueling; and contaminant (including fuel) management and storage. In the event of a contaminant spill, work at the site will

immediately cease until the contractor has contained, and mitigated the spill. The contractor will immediately prevent further contamination and notify appropriate authorities, and mitigate damage as appropriate. Adequate spill containment materials, such as oil diapers and hydrocarbon cleanup kits, shall be available on site at all times. Containers for storage, transportation, and disposal of contaminated absorbent materials will be provided on the project site.

17. An erosion control plan will be developed to ensure that during rain events, construction activities do not increase the levels of erosion and sedimentation. This plan will include the use of erosion control materials (i.e., baffles, fiber rolls, or hay bales; temporary containment berms) and erosion control measures such as straw application or hydroseeding with native grasses on disturbed slopes; and floating sediment booms and/or curtains to minimize any impacts that may occur due to increased mobilization of sediments.

18. Waste facilities shall be maintained. Waste facilities include concrete wash-out facilities, porta-potties, and hydraulic fluid containers. Waste shall be removed to a proper disposal site.

19. Ingress and egress points shall be clearly identified in the field using orange construction fence. Work shall not be conducted outside the designated work area.

20. A project completion report will be submitted within 60 calendar days of project completion. The activities for which these reports will be completed include the construction of the ponds, the construction of utility line and pole features, and the construction of each landfill cell. Annual monitoring reports regarding landfill construction activities and conservation parcel recovery will be submitted to the Service and CDFG for ten years.

21. To minimize disturbance of breeding and dispersing California tiger salamanders, all ground-disturbing construction activity on the conservation parcels will be conducted during the dry season (between April 15 and October 15). If ground-disturbing activities are necessary before or after the onset of the rainy season, the project proponent will contact the Service and CDFG to determine whether additional measures are necessary to minimize potential affects.

22. No ground-disturbing activities will occur on the conservation parcels within three days following a rain event.

23. No construction activities will occur until the Service and CDFG have received the signed documents, from a Service and CDFG-approved entity verifying the conservation easements and endowments for the Conservation Parcels.

24. PHLF purchased 1.9 acres created seasonal wetlands credits, 1.0 acre created seasonal ponds credits, 1.1 acres preserved seasonal ponds credits, 1.0 acre preserved/enhanced stream channel credits and their long-term management and monitoring and an endowment from Wetland Resources LLC.

Table I: Onsite Compensation, July 2010[1]

MITIGATION AREA	HABITAT TYPE								
	CTS Upland Habitat	Grassland **	CTS Pond Habitat		Seasonal Wetlands		Swale/Channel		TOTAL (acres)
	Preserve (acres)	*Preserve (acres)*	*Preserve (acres)*	*Create (acres)*	*Preserve (acres)*	*Create (acres)*	*Preserve (acres)*	*Create (acres)*	
Southern Hills	420.33	0.00	3.78	1.05	2.92	0.00	0.62 (4,230 ft)	0.00	**428.70**
Pond 5 Buffer Area	40.78	0.00	0.45	0.00	0.00	0.00	0.00	0.00	**41.23**
Eastern Valley†	159.16	0.00	0.50	0.00	0.20	0.00	0.14 (1,540 ft)	0.00	**160.00**
Eastern Hills†	136.88	0.00	0.00	0.00	0.004	0.00	0.51 (5,175 ft)	0.00	**137.39**
Griffith Ranch	105.99	0.00	0.00	0.73	0.34	4.07	0.00	1.03 (3,702 ft)	**112.16**
Director's Guild	0.00	20.74	0.00	0.00	61.66	0.42	0.21 (1,035 ft)	0.77 (1,898 ft)	**83.80**
TOTAL (acres)	**863.14**	**20.74**	**4.73**	**1.78**	**65.12**	**4.49**	**1.48 (11,980 ft)**	**1.80 (5,600 ft)**	**963.28**
Mitigation Ratio*	**5.2:1**	N/A	**7.7:1**	**2.9:1**	**45.9:1**	**3.2:1**	**3.4:1 (3.0:1)**	**4.1:1 (1.4:1)**	**5.7:1**

* Preserved/created:impacted
** Grassland on Director's Guild site is not occupied by CTS and not counted toward CTS mitigation.
N/A not applicable
†Eastern Valley parcel and Eastern Hills parcel were previously reported together as the Eastern Valley Area
Total Impact Area = 167.63 ac, Wetland Impact area = 1.86 (Seasonal Wetland = 1.42 ac, Waters = 0.44 ac. (Channel Length = 3,970 ft)) Pond Impact Area = 0.61 ac (Ponds 1 and 4), Upland Impact Area =165.16 ac

1 This table has been revised based on the revised delineation acreages for the Phase II Parcel and mitigation lands (Southern Hills, Eastern Valley, Eastern Hills, Griffith Ranch, Director's Guild parcels and the Pond 5 Buffer Area of the Phase II parcel). Field verifications with the Corps have been completed for all mitigation lands as of May 2010 and the acreages reported in this table are based on the field verified delineations. Jurisdictional determinations will be issued for each parcel concurrent with the individual permit. A jurisdictional determination for the Phase II parcel was issued by the Corps on February 26, 2010.

California Tiger Salamander Avoidance and Minimization Measures

Potrero Hills Landfill, Inc. proposes the following measures be implemented to avoid and minimize take of salamanders prior to ground disturbing activities at the landfill expansion site.

1. A permanent, salamander-proof barrier (e.g., fence) will be erected around the perimeter of the Phase II landfill expansion site at least 2 weeks prior to the start of construction activities to prevent salamanders from moving onto the expansion area during ground-disturbing activities and operation of the landfill. The barrier also may help direct the salamanders to areas where breeding ponds are preserved. The fence should be made of a material that does not allow California tiger salamanders to pass through, and the bottom should be buried to a depth of two inches so that this species cannot crawl under the fence. To avoid potential entanglement of listed species, the use of plastic monofilament netting will be prohibited. The design of the barrier will be approved by the Service and CDFG prior to ground disturbing activities on the Phase II expansion area. The barrier fence will be installed 2 weeks prior to the start of construction activities.

2. PHLF will implement the revised California tiger salamander salvage plan described in the August 31, 2010, memorandum to the Service. This plan will be followed to trap and remove adult California tiger salamanders from the Phase II Expansion site prior to ground disturbing activities.

3. A Service and CDFG-approved biologist will be onsite during initial ground disturbance to salvage any salamanders that are found during initial grading. This condition will apply to the initial site grading for each new landfill cell, perimeter road, barrier fence, and/or mitigation pond/feature. The Service and CDFG-approved biologist will look for listed species during all excavation activities. If a California tiger salamander is discovered, construction activities will cease in the immediate vicinity of the individual until the Service and CDFG are contacted and the individual has been removed from the construction area by a Service and CDFG-approved biologist. The individual should be released near the closest suitable burrow out of harms way. Prior to the start of daily construction activities, during initial ground disturbance, the Service and CDFG-approved biologist will inspect the perimeter fence to ensure that it is neither ripped nor has holes and that the base is still buried. The fenced area will also be inspected to ensure that no salamanders are trapped in it. Any salamanders found along and outside the fence will be removed from the fence area by a Service and CDFG-approved biologist and relocated to the nearest burrow.

4. All landfill activities and landfill employees will be restricted to the Phase II Expansion area, Phase I landfill, and public roads. Intrusions into the conservation sites will be allowed only for maintenance and monitoring activities, utility line construction, utility maintenance, or Service and CDFG-approved research activities as may be granted by Potrero Hills Landfill in the future.

Avoidance and Conservation Measures – Vernal Pool Crustaceans

In addition, Potrero Hills Landfill, Inc. will adhere to the following Avoidance and Conservation Measures for Vernal Pool Shrimp:

1. Before any construction activities begin on the Director's Guild Parcel, a Service and CDFG-approved biologist shall conduct a training session for all construction personnel. At a minimum, the training shall include a description of Conservancy fairy shrimp, vernal pool tadpole shrimp, and vernal pool fairy shrimp and their habitat, the importance of these species and their habitat, the general measures that are being implemented to conserve these species as they relate to the project, and the boundaries within which the project may be accomplished. If new construction personnel are added to the project, the contractor will ensure that the personnel receive the mandatory training before starting work. Brochures, books, and briefings may be used in the training session, provided that a qualified person is on hand to answer any questions.

2. Playa pool restoration and swale creation on the Director's Guild Parcel will occur during the dry season when vernal pools are typically dry and are not influenced by drainage patterns or hydrological connections.

Avoidance and Conservation Measures- Contra Costa Goldfields

In addition, Potrero Hills Landfill, Inc. will adhere to the following Avoidance and Conservation Measures for Contra Costa Goldfields:

1. Before any construction activities begin on the Director's Guild Parcel, a Service and CDFG-approved biologist shall conduct a training session for all construction personnel. At a minimum, the training shall include a description of the Contra Costa goldfield and its habitat, the importance of the Contra Costa goldfield and its habitat, the general measures that are being implemented to conserve Contra Costa goldfields as they relate to the project, and the boundaries within which the project may be accomplished. If new construction personnel are added to the project, the contractor will ensure that the personnel receive the mandatory training before starting work. Brochures, books, and briefings may be used in the training session, provided that a qualified person is on hand to answer any questions.

2. Prior to any construction activities, the Contra Costa goldfield area will be fenced off to prevent trampling of plants or disturbance of soil during construction activities.

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." The project site is located in the Potrero Hills of Solano County approximately 2 miles southeast of Suisun City and approximately 0.75 mile south of State Route (SR) 12. Travis Air Force Base is approximately 1 mile north of the project site. The landfill is accessed from SR 12 via Scally Road, Killdeer Road, and Potrero Hills Lane. The action area is the Phase II Expansion Area and the five conservation parcels.

The project site falls within Sections 3 and 10, Township 4 North, Range 1 West, on the Denverton, California 7.5 -minute series U.S. Geological Survey (USGS) quadrangle and encompasses approximately 167.63 acres. The conservation sites also lie within the Denverton quad and encompass approximately 963.28 acres.

The project site and conservation sites are located within an approximately 1,400-acre area owned by the applicant, Potrero Hills Landfill, Inc. Montezuma Slough and its associated marshes lie south of the Potrero Hills. The horseshoe-shaped ridges of the Potrero Hills surround the existing Phase I landfill and the footprint of the proposed Phase II Expansion Area.

Conservation will take place on six parcels: 1) the Southern Hills Parcel, 2) the Pond 5 Buffer Area on the Phase II Parcel, 3) the Eastern Valley Parcel, 4) the Eastern Hills Parcel, 5) the Griffith Ranch Parcel, and 6) the Director's Guild Parcel. The Southern Hills and Griffith Ranch Parcels are located immediately south and north of the Phase II Expansion Area, respectively. The Eastern Valley Parcel is located directly east of the Phase II Parcel. The Eastern Hills Parcel is located directly east of the Eastern Valley parcel. The Director's Guild Parcel is located about 0.25 miles north of the northern boundary of the expansion area along Scally Road.

Analytical Framework for the Jeopardy Analysis

Jeopardy Determination

In accordance with policy and regulation, the jeopardy analysis in this Biological Opinion relies on three components: (1) the *Status of the Species and Environmental Baseline*, which evaluates the tiger salamander, vernal pool fairy shrimp, vernal pool tadpole shrimp, Conservancy fairy shrimp, and Contra Costa goldfields range-wide conditions, the factors responsible for that condition, and their survival and recovery needs; and evaluates the condition of these listed species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of these animals; (2) the *Effects of the Action*, which determines the direct and indirect effects of the proposed Federal action and the effects of any interrelated or interdependent activities on these species; and (3) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on them.

In accordance with policy and regulation, this jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the tiger salamander, vernal pool fairy shrimp, vernal pool tadpole shrimp, Conservancy fairy shrimp, and Contra Costa goldfields 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 any of these species in the wild.

The jeopardy analysis in this Biological Opinion places an emphasis on consideration of the range-wide survival and recovery of the tiger salamander, vernal pool fairy shrimp, vernal pool tadpole shrimp, Conservancy fairy shrimp, and Contra Costa goldfields and the role of the action area in the survival and recovery of these listed 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.

Adverse Modification Determination

This Biological Opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat described within 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the Act to complete the following analysis with respect to critical habitat.

In accordance with policy and regulation, the adverse modification analysis in this biological opinion relies on four components: (1) the *Status of Critical Habitat*, which evaluates the range-wide condition of the designated critical habitat for the species in terms of Primary Constituent Elements (PCEs), the factors responsible for that condition, and the intended recovery function of the critical habitat overall; (2) the *Environmental Baseline*, which evaluates the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (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 PCEs and how that will influence the recovery role of affected critical habitat units; and (4) *Cumulative Effects*, which evaluates the effects of future, non-Federal activities in the action area on the PCEs and how that will influence the recovery role of affected critical habitat units.

For purposes of the adverse modification determination, the effects of the proposed Federal action on the critical habitat are evaluated in the context of the range-wide condition of the critical habitat, taking into account any cumulative effects, to determine if the critical habitat range-wide would remain functional (or would retain the current ability for the PCEs to be functionally established in areas of currently unsuitable but capable habitat) to serve the intended recovery role for the species.

The analysis in this Biological Opinion places an emphasis on using the intended range-wide recovery function of this listed species' critical habitat and the role of the action area relative to that intended function 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 adverse modification determination.

Status of the Species/Environmental Baseline/Critical Habitat

California Tiger Salamander

Status of the Species

On August 4, 2004, the Service listed the California tiger salamander as threatened throughout its range (Service 2004b). On August 19, 2005, U.S. District Judge William Alsup vacated the Service's down-listing of the Sonoma and Santa Barbara distinct population segment from endangered to threatened. Therefore, the Sonoma and Santa Barbara DPS are now listed as endangered. The Central Valley DPS remains listed as threatened. On August 23, 2005, the Service designated 199,109 acres of critical habitat for the Central Valley DPS in 19 counties (Service 2005c).

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). California tiger salamanders exhibit sexual dimorphism with males typically larger than females. The coloration of the tiger salamander is white or yellowish markings against black. As adults, tiger salamanders tend to have 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. Tiger salamander larvae have yellowish gray bodies, broad fat heads, large feathery external gills, and broad dorsal fins extending well up their back and range in length from approximately 0.45 to 0.56 inches (1.14 to 1.42 cm) (Petranka 1998).

The California tiger salamander has an obligate biphasic life cycle (Shaffer *et al.* 2004). Although larval salamanders develop in vernal pools and ponds in which they were born, they are otherwise terrestrial salamanders that spend most of their postmetamorphic lives in widely dispersed underground retreats (Shaffer *et al.* 2004; Trenham *et al.* 2001). Subadult and adult 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). The burrows provide protection from the sun and wind that can cause desiccation (drying out) of amphibian skin. Camel crickets (*Ceuthophilas* spp. and *Pristoceuthophilus* spp.) and other invertebrates within these burrows are likely prey for tiger salamander.

Tiger salamanders are members of the Family Ambystomatidae (mole salamanders); although members of this family are 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 in the uplands by humans even where they are abundant. Recent surveys performed within the East Bay Regional Parks District (EBRPD) have demonstrated that California tiger salamanders may utilize less than 50 percent of suitable breeding habitat during any given year. This data indicates that even in ponds where salamanders have not been observed, regular breeding activities may still occur (Bobzien and DiDonato 2007). Burrows may be active (in use by small mammals) or inactive (small mammals are absent), but because burrows tend to be short lived without continued small mammal activity, they typically collapse within approximately 18 months if not maintained (Loredo *et al.* 1996). An active population of burrowing mammals is necessary to sustain sufficient underground refugia for the species. California tiger salamanders also may utilize leaf litter or desiccation cracks in the soil.

The upland burrows inhabited by tiger salamanders have often been referred to as "aestivation" 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 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 2003, 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, tiger salamanders utilized vernal pools, but the animals also currently breed in livestock ponds. 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). California tiger salamander populations at eastern San Francisco Bay locations may have higher reproductive success in ponds with limited to no emergent vegetation, potentially due to a reduced number of aquatic predators that rely on more highly shaded areas (Bobzien and DiDonato 2007). After breeding, adults leave the pool and return to the small mammal burrows (Loredo *et al.* 1996; Trenham 1998a), although they may continue to emerge 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).

California tiger salamander eggs hatch in 2 to 4 weeks (Storer 1925). The larvae are aquatic with yellowish gray coloration 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 post hatching, after which they switch to larger prey (J. Anderson 1968). Larger larvae are known to consume tadpoles of Pacific tree frogs (*Pseudacris regilla*) and California red-legged frogs (J. Anderson 1968; P. Anderson 1968). The larvae are among the top aquatic predators in the seasonal pool ecosystems. Larval tiger salamanders often rest on the bottom in shallow water; they may also be found at varying depths in locations where deep water is available. 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). The peak emergence of these metamorphs is typically between mid-June to mid-July (Loredo and Van Vuren 1996; Trenham *et al.* 2000) but in some areas as early as late February or early March. 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 tiger salamanders, and five 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 ponds 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 when adult tiger salamanders typically move 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 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 (Trenham *et al.* 2000). However, the minimum age at sexual maturity has been observed to be 2 years for males and 2 to 3 years for females (Loredo and Van Vuren 1996; Trenham et al. 2000). Individuals 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 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. Data suggests that two reasons for the low reproductive success is that most individuals 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 anthropogenic factors that reduce breeding success and individual survival. Factors that repeatedly lower breeding success in isolated pools can quickly extirpate a population.

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 and 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 sites 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 from ponds, tiger salamanders may reside in burrows that are far from ponds. At one site in Contra Costa County, hundreds of tiger salamanders have been captured three years in a row in upland habitat approximately 0.75 miles 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 subadult California tiger salamanders disperse further into upland habitats than adults. A trapping study conducted in Solano County during winter of 2002/2003 found that subadults used upland habitats further from breeding ponds than adults (Trenham and Shaffer 2005). More subadults 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 subadult could be found within 2,067 feet (630 meters) of the pond, with the remaining 5 percent being found at even greater distances. Results from the 2003-04 trapping efforts detected subadult California tiger salamanders at even further distances, with a large proportion of the total salamanders caught at 2,297 feet from the breeding pond (Service 2004a). Most subadults captured, even those at 2,100 feet, were still moving away from ponds (Service 2004a). These data show that many tiger salamanders travel large distances while still in the juvenile/subadult stage. Post-breeding movements away from breeding ponds by adults appear to be much smaller. During post-breeding emigration, radio-tracked adult tiger salamanders were located in 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.

California tiger salamanders are also known to use several successive burrows at increasing distances from an associated breeding pond. Although previously sited studies provide information regarding linear movement from breeding ponds, upland habitat features appear to have some influence on movement. Trenham (2001) found that radio-tracked adults favored grasslands with scattered large oaks, over more densely wooded areas. The same study showed no indication that certain habitats type are favored as terrestrial travel corridors over others (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.

Historically, tiger salamanders 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 has been recorded from near sea level 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. Three distinct tiger salamander populations are recognized and correspond to the Santa Maria area within Santa Barbara County, the Santa Rosa Plain in Sonoma County, and vernal pool/grassland habitats throughout the Central Valley.

Documented and/or potential predators on tiger salamanders include coyotes, raccoons, striped skunks, opossums (*Didelphis virginiana*), egrets (*Egretta* spp.), great blue herons (*Ardea herodias*), crows (*Corvus brachyrhynchos*), ravens (*Corvus corax*), garter snakes (*Thamnophis* spp.), bullfrogs, California red-legged frogs, mosquito fish, and crayfish (*Procrambus* spp.). In addition, predacious aquatic hexapods (arthropods) have also been shown to have a significant negative association with California tiger salamanders (Bobzien and DiDonato 2007).

Diseases may pose a significant threat though the specific effects of disease on the tiger salamander are not known. Pathogens, fungi, water mold, bacteria, and viruses have been known to adversely affect other tiger salamander species and/or other amphibians. Pathogens are suspected of causing global amphibian declines (Davidson *et al.* 2003). Pathogen outbreaks have not been documented in the California tiger salamander, but chytrid fungus infections (chytridiomycosis) have been detected in California tiger salamander (Padgett-Flohr and Longcore 2005). Chytridiomycosis and ranaviruses are a potential threat to the California tiger salamander because these diseases have been found to adversely affect other amphibians, including tiger salamanders (Davidson *et al.* 2003; Lips *et al.* 2003). A deformity-causing infection, possibly caused by a parasite in the presence of other factors, has affected pond-breeding amphibians at known tiger salamander breeding sites. This same infection has become widespread among amphibian populations in Minnesota and poses the threat of becoming widespread in California. Non-native species, such as bullfrogs and non-native tiger salamanders, are located within the range of the California tiger salamander and have been identified as potential carriers of these diseases. Human activities can facilitate the spread of disease by encouraging the further introduction of non-native carriers and by acting as carriers themselves (i.e. contaminated boots or fishing equipment). Human activities can also introduce stress by other means, such as habitat fragmentation, that results in tiger salamanders being more susceptible to the effects of disease. Disease will likely become a growing threat because of the relatively small and fragmented remaining California tiger salamander breeding sites, the many stresses on these sites due to habitat losses and alterations, and the many other potential disease-enhancing anthropogenic changes that have occurred both inside and outside the species' range.

The California tiger salamander is imperiled throughout its range by a variety of human activities (Service 2004b). Current factors associated with declining populations of the salamander include continued degradation and loss of habitat due to agriculture and urbanization, hybridization with non-native eastern tiger salamanders (*Ambystoma tigrinum*) (Fitzpatrick and Shaffer 2004; Riley *et al.* 2003), and introduced predators. Fragmentation of existing habitat and the continued colonization of existing habitat by non-native tiger salamanders (and other species) may represent the most significant current threats to tiger salamanders, although populations are likely threatened by more than one factor. Isolation and fragmentation of habitats within many watersheds have precluded dispersal between sub-populations and jeopardized the viability of metapopulations (broadly defined as multiple subpopulations that occasionally exchange individuals through dispersal, and are capable of colonizing or "rescuing" extinct habitat patches). Other threats are predation and competition from introduced exotic species, possible commercial over utilization, various chemical contaminants, road-crossing mortality, and certain unrestrictive mosquito and rodent control operations. The various primary and secondary threats are not currently being offset by existing Federal, State, or local regulatory mechanisms. The tiger salamander is also vulnerable to chance environmental or demographic events, to which small populations are particularly vulnerable.

The Bay Area region occurs within the Central Coast and Livermore vernal pool regions (Keeler-Wolf *et al.* 1998). Vernal pools within the Coast Range are more sporadically distributed than vernal pools in the Central Valley (Holland 2003). In San Benito and Santa Clara counties, Central Coast vernal pools have been destroyed and degraded due to agriculture. The vernal pools at Stanford in Santa Clara County have been destroyed and degraded due to recreation and development (Keeler-Wolf *et al.* 1998). The annual loss of vernal pools from 1994 to 2000 in Monterey, San Benito, San Luis Obispo, Santa Barbara, and Ventura counties was 2 to 3 percent. This rate of loss suggests that vernal pools in these counties are disappearing faster than previously reported (Holland 2003). Most of the vernal pools in the Livermore Region in Alameda County have been destroyed or degraded by urban development, agriculture, water diversions, poor water quality, and long-term overgrazing (Keeler-Wolf *et al.* 1998). However, properly managed grazing is believed to be beneficial to the species in upland habitats as these activities promote the presence of burrowing fossorial mammals (Cook 2006). Additionally, the limited and carefully managed introduction of cattle into wetlands can reduce dense emergent vegetation that may attract predators as well as compress soils at the bottom of pools, deepening these areas and thus increasing their hydrologic inundation period (Bobzien and DiDonato 2007). Of the 140 tiger salamander localities where wetland habitat has been identified, only 7 percent were located in vernal pools. Due to the extensive losses of vernal pool complexes and their limited distribution in the Bay Area region, many tiger salamander breeding sites consist of artificial water bodies. In surveys performed in Alameda and Contra Costa counties, California tiger salamanders were found to breed almost exclusively in man-made stock ponds (Bobzien and DiDonato 2007). Use of these areas may place the tiger salamander at great risk of hybridization with non-native tiger salamanders. Without long-term maintenance, the longevity of artificial breeding habitats is uncertain relative to naturally occurring vernal pools that are dependent on the continuation of seasonal weather patterns. During the 1980s and 1990s, vernal pools were lost at a 1.1percent annual rate in Alameda County (Holland 1998).

Thirty-one percent (221 of 711 records and occurrences) of all California tiger salamander records and occurrences are in Alameda, Santa Clara, San Benito (excluding the extreme western end of the County), southwestern San Joaquin, western Stanislaus, western Merced, and southeastern San Mateo counties. Of these counties, most of the records are from eastern Alameda and Santa Clara counties (Service 2004b). The California Department of Fish and Game now considers 13 of these records from the Bay Area region as extirpated or likely to be extirpated.

The State Route 12 corridor in the Fairfield-Suisun-Rio Vista area, where the proposed project is located, has experienced rapid growth over the last several decades. The Association of Bay Area Governments (ABAG) anticipates continued growth in Solano County and expects the County to lead the Bay Area in percentage growth of both population and jobs through 2020. The California Department of Finance projects that Solano County's population will increase from 399,000 in 2000, to 564,900 by 2020, with most growth occurring within the County's three largest cities, Vallejo, Fairfield, and Vacaville. Rio Vista, while still a relatively small community, has led Solano County growth (on terms of percentage growth rate) for the last few years (SCWA 2007). Increased demand for housing likely will result in loss of suitable habitat for the salamander as housing developments replace agricultural and ranch lands. Increased urbanization in the region will contribute to the degradation of water quality in streams, altered flow regimes, increased contaminated road runoff, loss of upland habitat, and increased human presence in natural areas.

Environmental Baseline

PHLF is located within the Solano-Colusa vernal pool region and the Greater Jepson Prairie Core Area, which is a geographical area, defined by landscape and hydrological features that support a complex of vernal pools and a variety of associated endemic and special-status plant and animal species. The salamander is one of the primary species in the ecology of this vernal pool region. The salamander has been adversely affected by development and modification of the vernal pool, grassland, and open woodland habitat within the Solano-Colusa vernal pool region. Construction of and around PHLF contributed to local salamander habitat loss and fragmentation. The salamander is known to be present in much of the undeveloped areas surrounding the landfill. The action area is within the known salamander dispersal range from these salamander-occupied properties and there are no significant artificial, hydrological, or landscape barriers between these occupied areas and the action area.

The action area is located approximately 6 miles southwest of the Central Valley Region Unit 2 of critical habitat designated for the California tiger salamander. According to the California Natural Diversity Database (CDFG 2009), there are tiger salamander occurrences on the Phase II Expansion site (#485) in Pond 1, two occurrences on the Eastern Valley in Ponds 6 and 2 (#872 and #873), an occurrence in Pond 5 on the Pond 5 Buffer Parcel (#874), and an occurrence on the Southern Hills Parcel in Pond 7 (#875). Therefore, the Service has determined it is reasonable to conclude the California tiger salamander inhabits the action area, based on the biology and ecology of the species, the presence of suitable upland habitat, the presence of breeding habitat, as well as observations of the species on the proposed project site.

Vernal Pool Fairy Shrimp

Status of the Species

The vernal pool fairy shrimp was listed as threatened on September 19, 1994 (Service 1994). A detailed account of the taxonomy, ecology, and biology of the vernal pool fairy shrimp is presented in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005).

The vernal pool fairy shrimp has a delicate elongate body, large stalked compound eyes, no carapace, and 11 pairs of swimming legs. It swims or glides gracefully upside down by means of complex beating movements of the legs that pass in a wave-like anterior to posterior direction. Fairy shrimp feed on algae, bacteria, protozoa, rotifers, and bits of detritus. The females carry the eggs in an oval or elongate ventral brood sac. The eggs are either dropped to the pool bottom or remain in the brood sac until the female dies and sinks. The "resting" or "summer" eggs are capable of withstanding heat, cold, and prolonged desiccation. When the pools fill in the same or subsequent seasons, some, but not all, of the eggs may hatch. The egg bank in the soil may consist of eggs from several years of breeding (Donald 1983). The eggs hatch when the vernal pools fill with rainwater. The early stages of the vernal pool fairy shrimp develop rapidly into adults. These non-dormant populations often disappear early in the season long before the vernal pools dry up.

The vernal pool fairy shrimp inhabits vernal pools with clear to tea-colored water, most commonly in grass or mud-bottomed swales, or basalt flow depression pools in unplowed grasslands. The vernal pool fairy shrimp has been collected from early December to early May. It can mature quickly, allowing populations to persist in short-lived shallow pools (Simovich *et al.* 1992). Vernal pool fairy shrimp occupy a variety of different vernal pool habitats, from small, clear, sandstone rock pools to large, turbid, alkaline, grassland valley floor pools (Eng *et al.* 1990; Helm 1998;). The pool types where the species has been found include Northern Hardpan, Northern Claypan, Northern Volcanic Mud Flow, and Northern Basalt Flow vernal pools formed on a variety of geologic formations and soil types. Although vernal pool fairy shrimp have been collected from large vernal pools, including one exceeding 25 acres in area (Eriksen and Belk 1999), it is most frequently found in pools measuring fewer than 0.05 acre in area (Helm 1998; Gallagher 1996). The species occurs at elevations from 33 feet to 4,003 feet

(Eng *et al.* 1990), and is typically found in pools with low to moderate amounts of salinity or total dissolved solids (Keeley 1984; Syrdahl 1993). Vernal pools are mostly rain fed, resulting in low nutrient levels and dramatic daily fluctuations in pH, dissolved oxygen, and carbon dioxide (Keeley and Zedler 1998). Although there are many observations of the environmental conditions where vernal pool fairy shrimp have been found, there have been no experimental studies investigating the specific habitat requirements of this species.

The hydrology that maintains the pattern of inundation and drying characteristic of vernal pool habitats is complex. Vernal pool habitats form in depressions above an impervious soil layer (duripan) or rock substrate. After winter rains begin, this impervious layer prevents the downward percolation of water and creates a perched water table causing the depression (or pool) to fill. Due to local topography and geology, the depressions are generally part of an undulating landscape, where soil mounds are interspersed with basins, swales, and drainages (Nikiforoff 1941; Holland and Jain 1988). These features form an interconnected hydrological unit known as a vernal pool complex. Although vernal pool hydrology is driven by the input of precipitation, water input to vernal pool basins also occurs from surface and subsurface flow from the swale and upland portions of the complex (Zedler 1987, Hanes *et al.* 1990, Hanes and Stromberg 1998). Surface flow through the swale portion of the complex allows vernal pool species to move directly from one vernal pool to another. Upland areas are a critical component of vernal pool hydrology because they directly influence the rate of vernal pool filling, the length of the inundation period, and the rate of vernal pool drying (Zedler 1987; Hanes and Stromberg 1998).

The vernal pool fairy shrimp has evolved unique physical adaptations to survive in vernal pools. Vernal pool environments are characterized by a short inundation phase during the winter, a drying phase during the spring, and a dry phase during the summer (Holland and Jain 1988). The timing and duration of these phases can vary significantly from year to year, and in some years vernal pools may not inundate at all. In order to take advantage of the short inundation phase, vernal pool crustaceans have evolved short reproduction times and high reproductive rates. The listed crustaceans generally hatch within a few days after their habitats fill with water, and can start reproducing within a few weeks (Eng *et al.* 1990; Helm 1998; Eriksen and Belk 1999). Vernal pool crustaceans can complete their entire life cycle in a single season, and some species may complete several life cycles. Vernal pool crustaceans can also produce numerous offspring when environmental conditions are favorable. Some species may produce thousands of cysts during their life spans.

To survive the prolonged heat and dessication of the vernal pool dry phase, vernal pool crustaceans have developed a dormant stage. After vernal pool crustacean eggs are fertilized in the female's brood sac, the embryos develop a thick, usually multi-layered shell. When embryonic development reaches a late stage, further maturation stops, metabolism is drastically slowed, and the egg, now referred to as a cyst, enters a dormant state called diapause. The cyst is then either dropped to the pool bottom or remains in the brood sac until the female dies and sinks. Once the cyst is desiccated, it can withstand temperatures near boiling (Carlisle 1968), fire (Wells *et al.* 1997), freezing, and anoxic conditions without damage to the embryo. The cyst wall cannot be affected by digestive enzymes, and can be transported in the digestive tracts of animals without harm (Horne 1967). Most fairy shrimp cysts can remain viable in the soil for a decade or longer (Belk 1998).

Although the exact signals that cause crustacean cysts to hatch are unknown, factors such as soil moisture, temperature, light, oxygen, and osmotic pressure may trigger the embryo's emergence from the cyst (Brendonck 1990). Because the cyst contains a well-developed embryo, the animal can quickly develop into a fully mature adult. This allows vernal pool crustaceans to reproduce before the vernal pool enters the dry phase, sometimes within only a few weeks (Helm 1998, Eriksen and Belk 1999). In some species, cysts may hatch immediately without going through a dormant stage, if they are deposited while the vernal pool still contains water. These cysts are referred to as quiescent, and allow the vernal pool crustacean to produce multiple generations in a single wet season as long as their habitat remains inundated.

Another important adaptation of vernal pool crustaceans to the unpredictable conditions of vernal pools is the fact that not all of the dormant cysts hatch in every season. Hathaway and Simovich (1996) found that only 6 percent of endangered San Diego fairy shrimp (*Branchinecta sandiegonensis*) cysts hatched after initial hydration, and only 0.18 percent of Riverside fairy shrimp cysts hatched. The cysts that don't hatch remain dormant and viable in the soil. These cysts may hatch in a subsequent year, and form a cyst bank much like the seed bank of annual plants. The cyst bank may be comprised of cysts from several years of breeding, and large cyst banks of viable resting eggs in the soil of vernal pools containing fairy shrimp have been well documented (Belk 1998). Based on a review of other studies (e.g. Belk 1977; Gallagher 1996, Brendonck 1990), Hathaway and Simovich (1996) concluded that species inhabiting more unpredictable environments, such as smaller or shorter lived pools, are more likely to have a smaller percent of their cysts hatch after their vernal pool habitats fill with water. This strategy reduces the probability of complete reproductive failure if a vernal pool dries up prematurely. This kind of "bet-hedging strategy" has been suggested as a mechanism by which rare species may persist in unpredictable environments (Chesson and Huntly 1989; Ellner and Hairston 1994).

Upland areas associated with vernal pools are also an important source of nutrients to vernal pool organisms (Wetzel 1975). Vernal pool habitats derive most of their nutrients from detritus which is washed into the pool from adjacent uplands, and these nutrients provide the foundation for vernal pool aquatic communities' food chain. Detritus is a primary food source for the vernal pool crustaceans (Eriksen and Belk 1999).

Vernal pool fairy shrimp generally will not hatch until water temperatures drop to below 50°F (Gallagher 1996; Helm 1998). This species is capable of hatching multiple times within a single wet season if conditions are appropriate. Helm (1998) observed 6 separate hatches of vernal pool fairy shrimp within a single wet season, and Gallagher (1996) observed 3 separate hatches in vernal pools in Butte County.

Helm (1998) observed vernal pool fairy shrimp living for as long as 147 days. The species can reproduce in as few as 18 days at optimal conditions of 68°F and can complete its life cycle in as little as 9 weeks (Gallagher 1996; Helm 1998). However, maturation and reproduction rates of vernal pool crustaceans are controlled by water temperature and can vary greatly (Eriksen and Browne 1980; Helm 1998). Helm (1998) observed that vernal pool fairy shrimp did not reach maturity until 41 days at water temperatures of 59°F. Vernal pool fairy shrimp has been collected at water temperatures as low as 40°F (Eriksen and Belk 1999), however, the species has not been found in water temperatures above about 73°F (Helm 1998; Eriksen and Belk 1999).

The vernal pool fairy shrimp is known from 32 populations extending from Stillwater Plain in Shasta County through most of the length of the Central Valley to Pixley in Tulare County, and along the central coast range from northern Solano County to Pinnacles in San Benito County (Eng et al. 1990; Fugate 1992; Sugnet and Associates 1993) and a disjunct population on the Agate Desert in Oregon. Five additional, disjunct populations exist: one near Soda Lake in San Luis Obispo County; one in the mountain grasslands of northern Santa Barbara County; one on the Santa Rosa Plateau in Riverside County, one near Rancho California in Riverside County and one on the Agate Desert near Medford, Oregon. Three of these isolated populations each contain only a single pool known to be occupied by the vernal pool fairy shrimp. The genetic characteristics of these species, as well as ecological conditions, such as watershed continuity, indicate that populations of these animals are defined by pool complexes rather than by individual vernal pools (Fugate 1992). Therefore, the most accurate indication of the distribution and abundance of these species is the number of inhabited vernal pool complexes. Individual vernal pools occupied by these species are most appropriately referred to as subpopulations.

The primary historic dispersal method for the vernal pool fairy shrimp likely was large scale flooding resulting from winter and spring rains which allowed the animals to colonize different individual vernal pools and other vernal pool complexes. This dispersal currently is non-functional 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 likely are now the primary dispersal agents for vernal pool tadpole shrimp and vernal pool fairy shrimp (Brusca in. litt.; 1992, King in. litt., 1992; Simovich in. litt., 1992). The eggs of these crustaceans are either ingested (Krapu 1974; Swanson 1974; Driver 1981; Ahl 1991) and/or adhere to the legs and feathers where they are transported to new habitats.

Vernal pool crustaceans are often dispersed from one pool to another through surface swales that connect one vernal pool to another. These dispersal events allow for genetic exchange between pools and create a population of animals that extends beyond the boundaries of a single pool. Instead, populations of vernal pool crustaceans are defined by the entire vernal pool complex in which they occur (Simovich *et al.* 1992, King 1996). These dispersal events also allow vernal pool crustaceans to move into pools with a range of sizes and depths. In dry years, animals may only emerge in the largest and deepest pools. In wet years, animals may be present in all pools, or in only the smallest pools. The movement of vernal pool crustaceans into vernal pools of different sizes and depths allows these species to survive the environmental variability that is characteristic of their habitats.

Vernal pool crustaceans are an important food source for a number of aquatic and terrestrial species. Aquatic predators include insects such as backswimmers (Woodward and Kiesecker 1994), predaceous diving beetles and their larvae, and dragonflies and damselfly larvae. Vernal pool tadpole shrimp are another significant predator of fairy shrimp. Vernal pools provide important habitat for resident and migratory birds, particularly waterfowl and shorebirds. Birds are particularly attracted to the pools because they offer foraging habitat at a time of year when resources are limited (Silveira 1998), and vernal pools help link aquatic resources in the California portion of the Pacific Flyway. Vernal pool crustaceans provide important proteins and calcium vital to the energetic needs of migratory bird migration and reproduction (Proctor *et al.* 1967; Silveira 1998). Vernal pool crustaceans are a major food source for a number of terrestrial vertebrate predators including water fowl, wading birds, toads, frogs, and salamanders (Proctor *et al.* 1967; Krapu 1974; Swanson 1974; Morin 1987; Simovich *et al.* 1991; Silveira 1998). Vernal pool crustaceans depend on the absence of water during the summer months to discourage aquatic predator species such as bullfrogs, garter snakes, and fish (Eriksen and Belk 1999).

The vernal pool fairy shrimp is imperiled by a variety of human-caused activities, primarily urban development, water supply/flood control projects, and land conversion for agricultural use. Habitat loss occurs from direct destruction and modification of pools due to filling, grading, discing, leveling, and other activities, as well as modification of surrounding uplands which alters vernal pool watersheds. Other activities which adversely affect these species include off-road vehicle use, certain mosquito abatement measures, and pesticide/herbicide use. The main threat to listed vernal pool crustaceans is the loss of habitat associated with human activities, including urban/suburban development, water supply/flood control development, and conversion of natural lands to intensively farmed agricultural uses. According to the 1997 National Resources Inventory, released by the Natural Resources Conservation Service (2000), California ranked sixth in the nation in number of acres of private land developed between 1992 and 1997, at nearly 695,000 acres. Habitat loss occurs from direct destruction and modification of pools due to filling, grading, discing, leveling, and other activities, as well as modification of surrounding uplands which alters vernal pool watersheds. Other activities which adversely affect these species include off-road vehicle use, certain mosquito abatement measures, and pesticide/herbicide use, alterations of vernal pool hydrology, fertilizer and pesticide contamination, activity, invasions of aggressive non-native plants, gravel mining, and contaminated stormwater runoff. State and local laws and regulations do not protect listed vernal pool crustaceans, while other laws and regulations, including the Clean Water Act, have not effectively maintained habitat necessary to conserve and recover these species. Although developmental pressures continue, only a small fraction of vernal pool habitat is protected from the threat of destruction.

Holland (1978) estimated that between 67 and 88 percent of the area within the Central Valley of California which once supported vernal pools had been destroyed by 1973. However, an analysis of this report by the Service revealed apparent arithmetic errors which resulted in a determination that a historic loss between 60 and 85 percent may be more accurate. Regardless, in the ensuing years, threats to this habitat type have continued and resulted in a substantial amount of vernal pool habitat being converted for human uses in spite of Federal regulations implemented to protect wetlands. For example, the Corps' Sacramento District has authorized the filling of 467 acres of wetlands between 1987 and 1992 pursuant to Nationwide Permit 26 (Service 1992). The Service estimates that a majority of these wetland losses within the Central Valley involved vernal pools, the habitat of the vernal pool tadpole shrimp and vernal pool fairy shrimp. Current rapid urbanization and agricultural conversion throughout the ranges of these two species continue to pose the most severe threats to the continued existence of the vernal pool tadpole shrimp and vernal pool fairy shrimp. The Corps' Sacramento District has several thousand vernal pools under its jurisdiction (Coe 1988), which includes most of the known populations of these listed species. It is estimated that within 20 years 60 to 70 percent of these pools will be destroyed by human activities (Coe 1988).

In addition to direct habitat loss, the vernal pool habitat for the vernal pool tadpole shrimp and vernal pool fairy shrimp has been and continues to be highly fragmented throughout their ranges due to conversion of natural habitat for urban and agricultural uses. This fragmentation results in small isolated vernal pool tadpole shrimp and vernal pool fairy shrimp populations. Ecological theory predicts that such populations will be highly susceptible to extirpation due to chance events, inbreeding depression, or additional environmental disturbance (Gilpin and Soule 1986; Goodman 1987a, 1987b). If an extirpation event occurs in a population that has been fragmented, the opportunities for recolonization would be greatly reduced due to physical (geographical) isolation from other (source) populations.

Environmental Baseline

PHLF is located within the Solano-Colusa vernal pool region and the Greater Jepson Prairie Ecosystem, which is a geographical area, defined by landscape and hydrological features that support a complex of vernal pools and a variety of associated endemic and special-status plant and animal species. In addition, the action area is in Critical Habitat Unit 16A for vernal pool fairy shrimp. The fairy shrimp has been adversely affected by development and modification of the vernal pool and grassland habitat within the Solano-Colusa vernal pool region and known to be present in much of the undeveloped areas surrounding the landfill. The action area is within the known listed crustacean dispersal range and there are no significant artificial, hydrological, or landscape barriers between these occupied areas and the action area. Areas immediately adjacent to the action area have been assigned various designations relative to the ecological value of associated vernal pool habitat.

According to CDFG (2009), vernal pool fairy shrimp have been observed in the playa pool on the Director's Guild Parcel (# 184). Potentially suitable habitat for vernal pool fairy shrimp is found on all the parcels, but surveys by LSA have only confirmed their presence on the Director's Guild Parcel. Therefore, the Service believes that the vernal pool fairy shrimp is reasonably certain to occur within the action area because of the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the action area, as well as the recent observations of this listed species.

Vernal Pool Fairy Shrimp Critical Habitat

The Service designated critical habitat in 2005 (Service 2005b). In determining which areas to designate as critical habitat, the Service considers those physical and biological features (primary constituent elements) that are essential to the conservation of the species, and that may require special management considerations and protections (50 CFR § 424.14).

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

1. Topographic features characterized by mounds and swales and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools described below in paragraph (2)(ii), providing for dispersal and promoting hydroperiods of adequate length in the pools;

2. Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum of 18 days, in all but the driest years; thereby providing adequate water for incubation, maturation, and reproduction. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands;

3. Sources of food, expected to be detritus occurring in the pools, contributed by overland flow from the pools' watershed, or the results of biological processes within the pools themselves, such as single-celled bacteria, algae, and dead organic matter, to provide for feeding;

4. Structure within the pools described above in paragraph (3)(ii), consisting of organic and inorganic materials, such as living and dead plants from plant species adapted to seasonally inundated environments, rocks, and other inorganic debris that may be washed, blown, or otherwise transported into the pools, that provide shelter.

The entire Proposed PHLF Phase II Expansion Project is located within the vernal pool fairy shrimp critical habitat Unit 16A. Unit 16 encompasses approximately 12,576 acres and is essential to the conservation of the species because it is needed to maintain the current geographic and ecological distribution of the species. Unit 16A generally is located between Suisun City and Rio Vista to both the north and south of Highway 12. This unit is almost entirely privately owned.

Vernal Pool Tadpole Shrimp

Status of the Species

The vernal pool tadpole shrimp was listed as endangered on September 19, 1994 (Service 1994). A detailed account of the taxonomy, ecology, and biology of the vernal pool tadpole shrimp is presented in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005).

The species has dorsal compound eyes, a large shield-like carapace that covers most of the body, and a pair of long cercopods at the end of the last abdominal segment (Linder 1952; Longhurst 1955; Pennak 1989). It is primarily a benthic animal that swims with its legs down. Tadpole shrimp climb or scramble over objects, as well as move along or in bottom sediments. Their diet consists of organic detritus and living organisms, such as fairy shrimp and other invertebrates (Pennak 1989).

Vernal pool tadpole shrimp occur in a wide variety of vernal pool habitats including vernal pools, clay flats, ephemeral stock ponds, roadside ditches, and road ruts (Helm 1998). They have been found in pools with water temperatures ranging from 50 degrees Fahrenheit to 84 degrees Fahrenheit and pH ranging from 6.2 to 8.5 (Syrdahl 1993, King 1996). However, vernal pools exhibit daily and seasonal fluctuations in pH, temperature, dissolved oxygen, and other water chemistry characteristics (Syrdahl 1993, Scholnick 1995).

The life history of the vernal pool tadpole shrimp is linked to the phenology of its vernal pool habitat. After winter rainwater fills the pools, the populations are reestablished from diapaused eggs which lie dormant in the dry pool sediments (Lanway 1974; Ahl 1991). Ahl (1991) found that eggs in one pool hatched within three weeks of inundation and sexual maturation was reached in another three to four weeks. The eggs are sticky and readily adhere to plant matter and sediment particles (Simovich et al. 1992). A portion of the eggs hatch immediately and the rest enter diapause and remain in the soil to hatch during later rainy seasons (Ahl 1991). The vernal pool tadpole shrimp matures slowly and is a long-lived species (Ahl 1991). Adults are often present and reproductive until the pools dry up in the spring (Ahl 1991; Simovich *et al.* 1992).

Vernal pool tadpole shrimp have relatively high reproductive rates. Ahl (1991) found that fecundity increases with body size. Large females, greater than 0.8 inch carapace length, could deposit as many as 6 clutches, averaging 32 to 61 eggs per clutch, in a single wet season. Vernal pool tadpole shrimp sex ratios can vary (Ahl 1991).

After winter rains fill their vernal pool habitats, dormant vernal pool tadpole shrimp cysts may hatch in as little as 4 days (Ahl 1991). Additional cysts produced by adult tadpole shrimp during the wet season may hatch without going through a dormant period (Ahl 1991). Vernal pool tadpole shrimp emerge from their cysts as metanaupliu, a larval stage which lasts for 1.5 to 2 hours. They then molt into a larval form resembling the adult.

Helm (1998) found that vernal pool tadpole shrimp took a minimum of 25 days to mature and the mean age at first reproduction was 54 days. Other researchers have observed that vernal pool tadpole shrimp generally take between 3 and 4 weeks to mature (Ahl 1991; King 1996). Ahl (1991) found that reproduction did not begin until individuals were larger than 0.39 inch carapace length. Variation in growth and maturation rates may be a result of differences in water temperature, which strongly influences the growth rates of aquatic invertebrates.

King (1996) studied genetic variation among vernal pool tadpole shrimp populations at 20 different sites in the Central Valley. She found that 96 percent of the genetic variation measured was due to differences between sites. This result corresponds with the findings of other researchers that vernal pool crustaceans have low rates of gene flow between separated sites. The low rate of exchange between vernal pool tadpole shrimp populations is probably a result of the spatial isolation of their habitats and their reliance on passive dispersal mechanisms. However, King (1996) also estimated that gene flow between pools within the same vernal pool complex was much higher, and concluded that vernal pool crustacean populations should be defined by vernal pool complex, not by the boundaries of an individual vernal pool.

Based on genetic differences, King (1996) separated vernal pool tadpole shrimp populations into two distinct groups. One group was comprised of animals inhabiting the floor of the Central Valley, near the Sacramento and San Joaquin Rivers. The other group contained vernal pool tadpole shrimp from sites along the eastern margin of the valley. King (1996) concluded that these two groups may have diverged because cyst dispersal by overland flooding historically connected populations on the valley floor, while populations on the eastern margin of the valley were not periodically connected by large scale flooding, and were therefore historically more isolated. When dispersal of these foothill populations occurred, it was probably through different mechanisms such as migratory birds.

The vernal pool tadpole shrimp is known from 19 populations in the Central Valley, ranging from east of Redding in Shasta County south to Fresno County, and from a single vernal pool complex located on the San Francisco Bay National Wildlife Refuge in Alameda County. The species inhabits vernal pools containing clear to highly turbid water, ranging in size from 54 square feet in the Mather Air Force Base area of Sacramento County, to the 93 acre Olcott Lake at Jepson Prairie in Solano County. Vernal pools at Jepson Prairie and Vina Plains (Tehama County) have a neutral pH, and very low conductivity, total dissolved solids, and alkalinity (Barclay and Knight 1984; Eng et al. 1990). These pools are located most commonly in grass-bottomed swales of grasslands in old alluvial soils underlain by hardpan or in mud-bottomed claypan pools containing highly turbid water.

The main threat to the vernal pool tadpole shrimp is the loss of habitat associated with human activities, including urban/suburban development, water supply/flood control development, and conversion of natural lands to intensively farmed agricultural uses. According to the Natural Resources Conservation Service (2000), California ranked sixth in the nation in number of acres of private land developed between 1992 and 1997, at nearly 695,000 acres. Habitat loss occurs from direct destruction and modification of pools due to filling, grading, discing, leveling, and other activities, as well as modification of surrounding uplands which alters vernal pool watersheds. Other activities which adversely affect the species include off-road vehicle use, certain mosquito abatement measures, and pesticide/herbicide use, alterations of vernal pool hydrology, fertilizer and pesticide contamination, activity, invasions of aggressive non-native plants, gravel mining, and contaminated stormwater runoff. State and local laws and regulations do not protect the vernal pool tadpole shrimp, while other laws and regulations, including the Clean Water Act, have not effectively maintained habitat necessary to conserve and recover these species. Although developmental pressures continue, only a small fraction of vernal pool habitat is protected from the threat of destruction.

In addition to direct habitat loss, the vernal pool habitat for the vernal pool tadpole shrimp has been and continues to be highly fragmented throughout their ranges due to conversion of natural habitat for urban and agricultural uses. This fragmentation results in small isolated vernal pool tadpole shrimp populations. Ecological theory predicts that such populations will be highly susceptible to extirpation due to chance events, inbreeding depression, or additional environmental disturbance (Gilpin and Soule 1986; Goodman 1987a, 1987b). If an extirpation event occurs in a population that has been fragmented, the opportunities for recolonization would be greatly reduced due to physical (geographical) isolation from other (source) populations.

Environmental Baseline

The proposed project is located within the Solano-Colusa vernal pool region and the Greater Jepson Prairie Ecosystem, which is a geographical area, defined by landscape and hydrological features that support a complex of vernal pools and a variety of associated endemic and special-status plant and animal species. In addition, the action area lies within Critical Habitat Unit 11D for vernal pool tadpole shrimp. This listed crustacean has been adversely affected by development and modification of the vernal pool and grassland habitat within the Solano-Colusa vernal pool region and known to be present in much of the undeveloped areas surrounding the landfill. The action area is within the known vernal pool crustacean dispersal range and there are no significant artificial, hydrological, or landscape barriers between these occupied areas and the action area. Areas immediately adjacent to the action area have been assigned various designations relative to the ecological value of associated vernal pool habitat.

According to the CDFG (2009), vernal pool tadpole shrimp have been observed in the playa pool on the Director's Guild Parcel (# 111). Potentially suitable habitat for vernal pool tadpole shrimp is found on all the parcels, but surveys by LSA have only confirmed their presence on the Director's Guild Parcel. Therefore, the Service believes that the vernal pool tadpole shrimp is reasonably certain to occur within the action area because of the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the action area, as well as the recent observations of this listed species.

Vernal Pool Tadpole Shrimp Critical Habitat

In 2005, the Service designated critical habitat for the vernal pool tadpole shrimp (Service 2005b). In determining which areas to designate as critical habitat, the Service considers those physical and biological features (primary constituent elements) that are essential to the conservation of the species, and that may require special management considerations and protections (50 CFR § 424.14).

The PCEs of critical habitat for vernal tadpole shrimp are:

1. Topographic features characterized by mounds and swales and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools described below in paragraph (2)(ii), providing for dispersal and promoting hydroperiods of adequate length in the pools;

2. Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum of 18 days, in all but the driest years; thereby providing adequate water for incubation, maturation, and reproduction. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands;

3. Sources of food, expected to be detritus occurring in the pools, contributed by overland flow from the pools' watershed, or the results of biological processes within the pools themselves, such as single-celled bacteria, algae, and dead organic matter, to provide for feeding;

4. Structure within the pools described above in paragraph (3)(ii), consisting of organic and inorganic materials, such as living and dead plants from plant species adapted to seasonally inundated environments, rocks, and other inorganic debris that may be washed, blown, or otherwise transported into the pools, that provide shelter.

The entire Proposed PHLF Phase II Expansion Project is located within the vernal pool tadpole shrimp critical habitat Unit 11D, which is identical to critical habitat Unit 16A for vernal pool fairy shrimp. Unit 11 encompasses approximately 12,576 acres and is essential to the conservation of the species because it is needed to maintain the current geographic and ecological distribution of the species. Unit 11D generally is located between Suisun City and Rio Vista surrounding Highway 12. This unit is almost entirely privately owned.

Conservancy Fairy Shrimp

Status of the Species

The Conservancy fairy shrimp was described by Eng, Belk, and Eriksen (Eng *et al.* 1990). The type specimens were collected in 1982 at Olcott Lake in Solano County, California. The species name was chosen to honor The Nature Conservancy, an organization responsible for protecting and managing a number of vernal pool ecosystems in California, including several that support populations of this species. A detailed account of the taxonomy, ecology, and biology of the Conservancy fairy shrimp is presented in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005).

Conservancy fairy shrimp look similar to other fairy shrimp species. Conservancy fairy shrimp are characterized by the distal segment of the male's second antennae, which is about 30 percent shorter than the basal segment, and its tip is bent medially about 90 degrees (Eng *et al.* 1990). The female brood pouch is fusiform (tapered at each end), typically extends to abdominal segment eight, and has a terminal opening (Eng *et al.* 1990). Males may be from 0.6 to 1.1 inch in length, and females have been measured between 0.6 and 0.9 inch long. Conservancy fairy shrimp can be distinguished from the similar appearing midvalley fairy shrimp (*Branchinecta mesovallensis*) by the shape of two humps on the distal segment of the male's second antennae (Belk and Fugate 2000). The midvalley fairy shrimp's antennae is bent such that the larger of the two humps is anterior (towards the head), whereas this same hump in the Conservancy fairy shrimp is posterior (towards the tail). Females of these two species differ in the shape of their brood pouches. The brood pouch of the midvalley fairy shrimp is pyriform (pear-shaped) and extends to below abdominal segments three and four, as opposed to segment eight in Conservancy fairy shrimp (Belk and Fugate 2000).

The historical distribution of the Conservancy fairy shrimp is not known. However, the distribution of vernal pool habitats in the areas where the animal is now known to occur were once more continuous and larger in area than they are today (Holland 1998). It is likely this listed crustacean once occupied suitable vernal pool habitats throughout a large portion of the Central Valley and southern coastal regions of California.

The Conservancy fairy shrimp is known from a few isolated populations distributed over a large portion of California's Central Valley and in southern California. Populations of this species are found in the Solano-Colusa Vernal Pool Region on the greater Jepson Prairie area in Solano County, at the Sacramento National Wildlife Refuge in Glenn County, and in the Tule Ranch unit of the California Department of Fish and Game Yolo Basin Wildlife Area in Yolo County.

The Conservancy fairy shrimp occurs in vernal pools found on several different landforms, geologic formations, and soil types. At the Vina Plains in Tehama County, the species occurs in pools formed on Peters Clay soil on the volcanic Tuscan Formation. At Jepson Prairie, the Conservancy fairy shrimp is found in large playa-like depressions on deep alluvial soils of Pescadero Clay Loam on Basin Rim landforms. Vernal pools that contain Conservancy fairy shrimp in the Los Padres National Forest tend to occupy atypical habitat settings that are located under pine forest canopy instead of annual grassland. The species has been collected in vernal pools ranging from 6.5 feet^2 to 88 acres in surface area (Helm 1998). Observations suggest this species often is found in pools that are relatively large, and turbid (King 1996, Helm 1998, Eriksen and Belk 1999). Helm (1998) found the mean size of pools supporting this species to be 299,936 square feet, much larger than the average mean size of all other species he observed. Syrdahl (1993) found positive correlations between Conservancy fairy shrimp occurrence and large pool surface areas. The species has been found at sites that are low in alkalinity (16 to 47 parts per million) and total dissolved solids (20 to 60 parts per million), with pH near 7 (Barclay and Knight 1984, Syrdahl 1993, Eriksen and Belk 1999). Conservancy fairy shrimp have been found at elevations ranging from 16 feet to 5,577 feet (Eriksen and Belk 1999), and at water temperatures as high as 73 degrees Fahrenheit (Syrdahl 1993).

The Conservancy fairy shrimp co-occurs with several other vernal pool crustacean species, including the vernal pool fairy shrimp, the California fairy shrimp (*Linderiella occidentalis*), and the vernal pool tadpole shrimp (King 1996; Helm 1998, Eriksen and Belk 1999). These species may all be found in one general location, however, they have rarely been collected from the same pool at the same time (Eriksen and Belk 1999). In general, Conservancy fairy shrimp have very large populations within a given pool, and is usually the most abundant fairy shrimp when more than one species is present (Helm 1998, Eriksen and Belk 1999). The Conservancy fairy shrimp is a prey species for the vernal pool tadpole shrimp (Alexander and Schlising 1997), as well as a variety of insect and vertebrate predator species. The Conservancy fairy shrimp also co-occurs with several plants found in large vernal pools, including threatened Colusa grass (*Neostapfia colusana*) and various Orcutt grasses.

Environmental Baseline

The action area is within the known range of the Conservancy fairy shrimp in the Solano-Colusa Vernal Pool Region as defined in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005). In the Solano-Colusa region, Conservancy fairy shrimp populations are protected from development on some locations at the Jepson Prairie Preserve, however, specific management and monitoring for the species is not currently conducted at these sites. Additional occurrences of the species on private land in this region are threatened by development, particularly in the rapidly urbanizing areas of Fairfield and Vacaville. This listed crustacean has been adversely affected by development and modification of the vernal pool and grassland habitat within the Solano-Colusa vernal pool region and known to be present in much of the undeveloped areas surrounding the landfill. Construction of and around PHLF contributed to local Conservancy shrimp habitat loss and fragmentation.

The project is also located within Critical Habitat Unit 3 for Conservancy fairy shrimp. According to the CDFG (2009), Conservancy fairy shrimp have been observed in the playa pool on the Director's Guild Parcel (# 14). Potentially suitable habitat for Conservancy fairy shrimp is found on all the parcels, but surveys by LSA have only confirmed their presence on the Director's Guild Parcel. Therefore, the Service believes that the Conservancy fairy shrimp is reasonably certain to occur within the action area because of the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the action area, as well as the recent observations of this listed species.

Conservancy Fairy Shrimp Critical Habitat

The Service designated critical habitat for the Conservancy fairy shrimp in 2005 (Service 2005b). In determining which areas to designate as critical habitat, the Service considers those physical and biological features (primary constituent elements) that are essential to the conservation of the species, and that may require special management considerations and protections (50 CFR § 424.14).

The PCEs of critical habitat for Conservancy fairy shrimp are:

1. Topographic features characterized by mounds and swales and depressions within a matrix of surrounding uplands that result in complexes of continuously, or intermittently, flowing surface water in the swales connecting the pools described below in paragraph (2)(ii), providing for dispersal and promoting hydroperiods of adequate length in the pools;

2. Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water for a minimum of 18 days, in all but the driest years; thereby providing adequate water for incubation, maturation, and reproduction. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands;

3. Sources of food, expected to be detritus occurring in the pools, contributed by overland flow from the pools' watershed, or the results of biological processes within the pools themselves, such as single-celled bacteria, algae, and dead organic matter, to provide for feeding;

4. Structure within the pools described above in paragraph (3)(ii), consisting of organic and inorganic materials, such as living and dead plants from plant species adapted to seasonally inundated environments, rocks, and other inorganic debris that may be washed, blown, or otherwise transported into the pools, that provide shelter.

The Director's Guild and Griffith Ranch Parcels are located within the Conservancy fairy shrimp critical habitat Unit 3. This unit encompasses approximately 4,414 acres and is essential to the conservation of the species because it is needed to maintain the current geographic and ecological distribution of the species. Unit 3 generally is located between Suisun City and Rio Vista surrounding Highway 12. This critical habitat overlaps a portion of vernal pool fairy shrimp critical habitat Unit 16A and tadpole fairy shrimp critical habitat Unit 11D, but extends farther south. This unit is entirely privately owned.

Contra Costa Goldfields

Status of the Species

The Service listed Contra Costa goldfields as an endangered species in 1997 (Service 1997). This species does not currently have any State listing status. The California Native Plant Society has considered Contra Costa goldfields rare and endangered since the organization's first list was published (Powell 1974); Contra Costa goldfields are currently on List 1B, the highest endangerment rating possible (Skinner and Pavlik 1994). A detailed account of the taxonomy, ecology, and biology of Contra Costa goldfields is presented in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005).

Greene (1888) first described Contra Costa goldfields, naming this species *Lasthenia conjugens*. The type locality is Antioch, in Contra Costa County (Greene 1888). Hall (1914) later synomized Contra Costa goldfields under the common species Fremont's goldfields, which at that time was called *Baeria fremontii*. Ferris (1958) proposed the name *Baeria fremontii* var. *conjugens* to recognize the distinctiveness of Contra Costa goldfields. Finally, Ornduff (1966) restored Greene's original name and rank, returning this species to the genus *Lasthenia*. The two closest relatives of Contra Costa goldfields are *L. burkei* (Burke's goldfields) and *L. fremontii* (Fremont's goldfields).

The stems of Contra Costa goldfields are 4 to 12 inches tall, somewhat fleshy, and usually branched. The leaves are opposite and narrow; the lower leaves are entire, but stem leaves have one or two pairs of narrow lobes. The daisy-like flower heads are solitary. Both the disk and ray flowers are golden-yellow, and the ligules are 0.20 to 0.39 inch long. Each head has numerous disk flowers and 6 to 13 ray flowers. The club-shaped achenes are no more than 0.06 inch long and are shiny, olive-green, hairless, and lack a pappus (Greene 1888, Ornduff 1993b). Contra Costa goldfields has a diploid chromosome number of 12 (Ornduff 1966; Ornduff 1993b). Whereas all other species of *Lasthenia* have either completely free phyllaries or phyllaries fused more than two-thirds of their length, Contra Costa goldfields has phyllaries fused from one-quarter to one-half their length. The free phyllaries and presence of a pappus distinguish both *L. burkei* and *L. fremontii* from Contra Costa goldfields (Ornduff 1969; Ornduff 1979; Ornduff 1993b). *Blennosperma* species can be differentiated from *Contra Costa goldfields* by the alternate leaves, clustered (as opposed to solitary) flower heads, and paler yellow ligules of the former (Ornduff 1993a,b).

Contra Costa goldfields occurred historically in seven vernal pool regions: Central Coast, Lake-Napa, Livermore, Mendocino, Santa Barbara, Santa Rosa, and Solano-Colusa (Keeler-Wolf *et. al.* 1998). In addition, several historical occurrences in Contra Costa County are outside of the defined vernal pool regions (Keeler-Wolf *et al.* 1998, CDFG 2009). Many collection sites from the late 19th and early 20th centuries are difficult to pinpoint because locality information on specimen labels often was vague. Ornduff (1966) reported collections from 13 sites in Alameda, Contra Costa, Mendocino, Napa, Santa Barbara, Santa Clara, and Solano Counties. Although he cited three specimens each from Contra Costa (including the type) and Santa Barbara Counties, Ornduff (1966, 1979) noted that the species was most common in Solano County. One additional site in Alameda County was documented in 1959 by G. Thomas Robbins, who collected a specimen (# 3963, housed at the Jepson Herbarium) on the "shore of San Francisco Bay" south of Russell.

Of the 32 occurrences of Contra Costa goldfields recorded between 1884 and 2008 that are currently (through 2009) catalogued in the CDFG (2009), 20 are likely extant. Two additional populations exist at the former Fort Ord site that have not been reported to the California Natural Diversity Database (W. Collins, U.S. Army, pers. comm. 2005). Thus the total number of likely extant populations is 22. However, there is uncertainty due in part to the difficulty of relocating sites based on early vague site descriptions and also because this species may reappear on a site after several years, even if it is absent during a given survey. Contra Costa goldfields presumably remains in all of the vernal pool regions where it occurred historically, except for the Santa Barbara, Livermore, and Mendocino Vernal Pool Regions. However, by far the greatest concentration of this species is in the Solano-Colusa Vernal Pool Region; where 10 occurrences that are presumed extant, plus 1 that may be extirpated. Five occurrences are extant in the Central Coast Vernal Pool Region, including three at the former Fort Ord in Monterey County, one at San Francisco Bay National Wildlife Refuge, and one near Fremont, both in Alameda County (CDFG 2009).

Germination, growth, reproduction, and demography are likely to be similar to *Lasthenia burkei*, a close relative that has been studied more intensively. As a vernal pool annual plant, seeds of Contra Costa goldfields would be expected to germinate in response to autumn rains, with the plants maturing in a single growing season, setting seed, and dying back during the summer. However, detailed research on the life cycle has not been conducted. Laboratory germination tests on the related species *L. burkei* (Rancho Santa Ana Botanical Garden unpublished data), indicated that germination occurs rapidly in a single flush (peak germination date the same as first germination date), with relatively high germination rates (49 to 100 percent). *Lasthenia burkei* plants that establish in autumn under natural conditions may tolerate prolonged submergence but do not begin rapid stem growth until vernal pools and swales drain down during late winter or early spring (Ornduff 1969, Patterson *et al.* 1994).

Contra Costa goldfields flowers from March through June (Ornduff 1966, Ornduff 1979, Skinner and Pavlik 1994). The flowers are self-incompatible (Crawford and Ornduff 1989). Although Contra Costa goldfields has not been the subject of pollinator studies, observations suggest that the same insects visit all outcrossed species of *Lasthenia*, rather than concentrating on any particular species (Thorp 1976). Insect visitors to flowers of *Lasthenia* belong to five orders: Coleoptera, Diptera, Hemiptera, Hymenoptera, and Lepidoptera (Thorp and Leong 1998). Most of these insects are generalist pollinators. All of the specialist pollinators of *Lasthenia* are solitary bees of the family Andrenidae; these pollinators include *Andrena submoesta, A. puthua, A.baeriae, A. duboisi, A. lativentris,* and two or three undescribed species (Thorp and Leong 1998). The extent to which pollination of Contra Costa goldfields depends on host-specific bees or more generalist pollinators is currently unknown.

Seed dispersal mechanisms in Contra Costa goldfields are unknown. However, the lack of a pappus or even hairs on the achenes makes wind dispersal unlikely (Ornduff 1976). Seed longevity, survival rates, fecundity, and other demographic parameters have not been investigated. However, as with other vernal pool annuals, population sizes have been observed to vary by up to four orders of magnitude from year to year (CDFG 2009). Thus, this species most likely forms a persistent soil seed bank. Seeds of the related species *L. burkei* have been stored artificially for many years with little loss of viability (C. Patterson, pers. comm.). However, the maximum duration of viable seed in the soil is not known.

Contra Costa goldfields typically grow in vernal pools, swales, moist flats, and depressions within a grassland matrix (CDFG 2009). However, several historical collections were from populations growing in the saline-alkaline transition zone between vernal pools and tidal marshes on the eastern margin of the San Francisco Bay (P. Baye 2000). The herbarium sheet for one of the San Francisco Bay specimen's notes that the species also grew in evaporating ponds used to concentrate salt (P. Baye 2000). The vernal pool types from which this species has been reported are Northern Basalt Flow, Northern Claypan, and Northern Volcanic Ashflow (Sawyer and Keeler-Wolf 1995). The landforms and geologic formations for sites where Contra Costa goldfields occur have not yet been determined. Most occurrences of Contra Costa goldfields are at elevations of 6 to 200 feet, but the recently discovered Monterey County occurrences are at 400 feet and one Napa County occurrence is at 1,460 feet elevation (CDFG 2009). The soil types have not yet been identified for most *Contra Costa goldfields* localities. However, soil series from which it is known are: Aiken, Antioch, Concepcion, Conejo, Crispin, Haire, Linne, Los Robles, Rincon, Solano, and San Ysidro, plus the Arnold-Santa Ynez, Hambright-rock outcrop, and Los Osos complexes. Soil textures, where known, are clays or loams. At least in Solano County and on the shores of San Francisco Bay, Contra Costa goldfields grow in alkaline or saline-alkaline sites (P. Baye 2000, CDFG 2009).

Many plant species grow in association with Contra Costa goldfields in various parts of its range, but no comprehensive survey of associates has been undertaken. The two most commonly reported associates are *Lolium multiflorum* (Italian ryegrass) and *Plagiobothrys* spp. (popcorn flower). Other plant species that occur at several Contra Costa goldfields sites include *Cotula coronipifolia* (brass buttons), *Downingia pulchella* (valley downingia), *Eryngium aristulatum* (California eryngo), *Lasthenia glaberrima* (smooth goldfields), *Myosurus minimus* (common mousetail), and *Pleuropogon californicus* (California semaphore grass).

With the exception of Travis Air Force Base, the entire Contra Costa goldfields concentration area in Solano County is within the City of Fairfield's sphere of influence and subject to relatively intense development pressure under the City's general plan. Numerous construction projects, including residential development, landfill expansion, and drainage channels, are proposed and pose specific threats (Service 1997). Threats due to conversions to vineyards are also continuing. The largest Napa County occurrence of this plant, at Suscol Ridge (CDFG 2009), is imminently threatened by vineyard conversion; the site is already under a 25-year lease to a winery (P. Baye 2000). Competition from non-native plants, particularly *Lolium multiflorum* (Italian ryegrass), threatens at least seven occurrences of Contra Costa goldfields, several of which are also targeted for development (CDFG 2009). Non-native grasses such as *Lolium multiflorum* not only shade out short statured plants like Contra Costa goldfields, but can also negatively impact vernal pool hydrology by decreasing inundation periods in pools (Marty 2004). In addition, encroachment by non-native plants often follows surface-disturbing activities, such as discing, grading, filling, ditch construction, and off-road vehicle use, which can alter hydrology and microhabitat conditions (Service 2005a). Management strategies including grazing, mowing, and burning are vital to controlling these weed species. CDFG (2009) also cites inappropriate livestock grazing practices as a threat to seven occurrences of Contra Costa goldfields. However, the removal of livestock grazing from at least one site in Contra Costa County has caused significant population declines in this species (J. Marty, pers. comm. 2004). Therefore, the complete elimination of grazing, as well as overgrazing, may have adverse impacts to the Contra Costa goldfields.

Five occurrences of Contra Costa goldfields are on public lands: three at Fort Ord, and one each at San Francisco Bay National Wildlife Refuge and Travis Air Force Base. These lands are administered by the U.S. Bureau of Land Management, the U.S. Fish and Wildlife Service, and the U.S. Air Force, respectively. All of the Fort Ord occurrences are on land within the Habitat Management Plan Habitat Reserve lands and will be conserved and managed in perpetuity (W. Collins *in litt.* 2005; U.S. Army Corps of Engineers 1997). The population at Travis Air Force Base, including over 20 acres of adjacent restored vernal pools, is protected as a special ecological preserve, with protective measures and appropriate management for the species provided in the Travis Air Force Base Land Management Plan. Seasonal managed cattle grazing has been returned to two conservation sites supporting Contra Costa goldfields: 1) the Warm Springs Seasonal Wetland Unit of the Don Edwards San Francisco Bay National Wildlife Refuge in Alameda County, and 2) the State Route 4 Preserve managed by the Muir Heritage Land Trust in Contra Costa County. The Contra Costa goldfields population at the Warm Springs Unit has declined during the last 10 years due to many factors including competition by non-native plant species. During this time period, grazing, which occurred intermittently at the Warm Springs Unit since the 1800s, has been excluded by the Refuge until a management plan could be developed. The decline in the Contra Costa goldfields population at the Warm Springs Unit cannot be attributed to a single factor, but most likely results from the complex interaction of several variables including current and historical land uses, the abiotic environment, and annual climatic variation. The increasing dominance of non-native grasses, however, coincides with the suspension of livestock grazing, suggesting that the lack of a disturbance regime may be a primary factor in the degradation of habitat for Contra Costa goldfields at this site (Service 2005a). The population of Contra Costa goldfields at the State Route 4 Preserve, which was protected as part of compensation for the construction of the State Route 4 Gap Closure Project, has also declined in recent years. The decline may be due to a number of causes, including below normal precipitation and competition from non-native species (Pardieck 2003). The site had been grazed heavily for many years resulting in stream channel erosion. Grazing was suspended in 2000 and the numbers of plants dropped sharply in 2001 and continued to decline the following year. Controlled grazing has been reintroduced to control the amount of seed and thatch produced by non-native plants.

Historically, the Contra Costa goldfields present in Solano County were probably part of one large and interconnected population. However, the conversion of land to agricultural use and urban development which has become more pronounced over the past 60 years has artificially isolated populations of Contra Costa goldfields from each other, resulting in 5 distinct sub-populations in the area. While these populations are fragments of a previously larger population, they are nevertheless sizeable individually at least in terms of total numbers of plants, ranging in size from 100,000 plants to over 30 million (LSA 2007). These five primary populations are demarcated based on soil type and watershed association. A description of each primary population follows:

Northeast Fairfield is several sub-populations, separated from each other by existing roads and developments for the most port, exist in northeast Fairfield. These populations are located within the watersheds of McCoy and western Union Creek. The total population is typically in excess of at least 8-10 million individuals annually given weather conditions and grazing regimes (LSA 2007). Potrero Hills Flats has two sub-populations in this area. One large sub-population occurs at the base of the Potrero Hills at the lower end of the watershed of Union Creek. A second, small sub-population exists to the east in the flats north of Hwy 12, within the lower Denverton Creek watershed. Cordelia Road has one small, remnant population which exists near Cordelia Road in the flats south of a rock quarry, southwest of Fairfield at the lower end of the watershed of Dan Wilson Creek. Lower Ledgewood Creek has a small population occurring in the lower reaches of the watershed of Ledgewood Creek, southwest of Fairfield. Vanden Road is a small population which has been historically reported as occurring in low areas along the railroad tracks that parallel Vanden Road, north of Travis Air Force Base in the upper region of the watershed of Union Creek. This population appears to be extinct, although other undocumented populations may be present in vernal pool habitats east of Vanden Road (LSA 2007).

Environmental Baseline

The Contra Costa goldfields in the action area are the large sub-population mentioned above as the Potrero Hills Flats. They occur only on the Director's Guild Parcel north of the Potrero Hills Landfill (CNDDB #20). Therefore, the Service has determined that Contra Costa goldfields occur within the action area because of the biology and ecology of the plant, the presence of suitable habitat in the action area, as well as the observations of this listed species in the action area.

Contra Costa Goldfields Critical Habitat

The Service designated critical habitat for the Contra Costa goldfields in 2005 (Service 2005b). In determining which areas to designate as critical habitat, the Service considers those physical and biological features (primary constituent elements) that are essential to the conservation of the species, and that may require special management considerations and protections (50 CFR § 424.14).

The PCEs of critical habitat for Contra Costa goldfields are:

1. Topographic features characterized by isolated mound and intermound complex within a matrix of surrounding uplands that result in continuously, or intermittently, flowing surface water in the depressional features including swales connecting the pools described below in paragraph (2)(ii), providing for dispersal and promoting hydroperiods of adequate length in the pools;

2. Depressional features including isolated vernal pools with underlying restrictive soil layers that become inundated during winter rains and that continuously hold water or whose soils are saturated for a period long enough to promote germination, flowering, and seed production of predominantly annual native wetland species and typically exclude both native and non-native upland plant species in all but the driest years. As these features are inundated on a seasonal basis, they do not promote the development of obligate wetland vegetation habitats typical of permanently flooded emergent wetlands.

Portions of the proposed project are located within the southwestern corner of Contra Costa goldfields critical habitat Unit 4C. Unit 4C represents 30% of all critical habitat for Contra Costa goldfields. This unit encompasses approximately 4,414 acres and is essential to the conservation of the species because it is needed to maintain the current geographic and ecological distribution of the species. Unit 4C generally is located along Highway 12 East of Suisun City, in Solano County, California.

Effects of the Proposed Action

California Tiger Salamander

The proposed project is likely to result in a number of adverse effects to the California tiger salamander. Individual animals may be directly injured, killed, harmed, and harassed by activities that disturb breeding, migration, dispersal, and aestivation habitat. The proposed project will permanently eliminate upland and breeding habitat of the salamander. Individuals exposed during excavations likely will be crushed and killed or injured by construction-related activities. Salamanders also could fall into the trenches, pits, or other excavations, and then they could be directly killed or be unable to escape and be killed due to desiccation, entombment, or starvation. The increased landfill size and increased hours of operation will lead to higher levels of vehicle traffic which will result in higher numbers of California tiger salamanders killed during their movements between their upland habitat and breeding ponds.

Construction of the Phase II expansion would result in the permanent loss of approximately 165.16 acres of tiger salamander upland habitat, the permanent loss of 1.86 acres of tiger salamander wetland dispersal habitat, and the permanent loss 0.61 acres of tiger salamander breeding habitat due to the loss of Pond 1 (0.39 acre) and Pond 4 (0.22 acre). The creation of ponds, seasonal wetlands, and swales/channels on the Southern Hills, Griffith Ranch, and Eastern Valley Parcels will minimize the effects of this loss, but also result in the loss of 6.88

acres of tiger salamander upland habitat. This trade-off of uplands for aquatic habitat will result in a net benefit to the species by increasing the amount of breeding habitat in the area. The powerline extension would result in 0.01 acre of temporary effects to tiger salamander upland during installation and 0.001 acre permanent effects to tiger salamander upland habitat from the new poles. The installation of the buried pipe line system and 4 troughs will temporarily affect 0.027 acre and permanently affect 0.002 acre of upland tiger salamander habitat on the Southern Hills Parcel.

The increase in night lighting of the landfill could disrupt tiger salamander physiology and behavior. Artificial light during normally dark periods can disrupt the production of melatonin (Vanecek 1998). Under natural conditions, aquatic adult eastern tiger salamanders have higher plasma levels of melatonin during scotophase (the dark period of a day-night cycle) than during photophase (the light period of a day-night cycle) (Gern and Norris 1979). Gern *et al* (1983) found that eastern tiger salamanders under constant light did not show significant differences in melatonin levels between photophase and scotophase. Melatonin in amphibians has multiple effects, such as reducing tolerance to high temperatures and lower body temperature (Erskine and Hutchison 1982; Hutchison *et al* 1979). One hypothesis is that artificially increasing the length of photophase through night lighting may disrupt normal cyclical changes in metabolic rates, changing the energy demands of salamanders (Wise and Buchanan 2006). This effect could become problematic during periods of low food availability or when energetic demands are especially high, such as during egg production or periods of drought (Perry *et al* 2008). Salamander behavior has also been shown to be affected by light levels. The diel pattern of vertical migration exhibited by larval salamanders (*Ambystoma jeffersonianum*, *A. opacum*, *A. talpoideum*, and *A. tigrinum*) has been shown to be influenced by ambient light, temperature, competition, and predation risk (Anderson and Graham 1967; Stangel and Semlitsch 1987). *A. opacum* exhibited more activity on overcast days and less vertical migration on bright nights (Anderson and Graham 1967). Semlitsch (1987) found that an interruption of vertical migration may reduce size at metamorphosis or survival.

The effects of increased lighting will be minimized by using a small number of lights in a manner that avoids off-site reflection and glare. Portable construction lighting units would be stationed at the active face of the landfill. A maximum of seven construction light plants will be used at the site. With respect to Pond 5, the nearest landfill operation will be about 800 feet away. Operations in Cell 25 at the southeast corner of the site may occur in steps as the first lifts are placed, and later as the upper portion of the landfill is constructed. These may involve operating for only 1 or 2 months at a time in that location, in the last few years of site operation. With respect to Pond 3, the nearest landfill location (Cells 24 & 25) would be about 300 feet away. The time when operations would occur there may be 3 or 4 months at a time, in two time periods, a year or two apart. Those operations would also be near the last few years of site operation.

Direct effects from the expansion will be minimized by a pre-construction tiger salamander salvage plan during the dry season. Preconstruction surveys for tiger salamanders and relocating individuals may reduce injury or mortality. However, the capture and handling of tiger salamanders to remove them from the work area may result in the harassment, mortality, or injury of individuals. The applicant proposes to reduce or prevent injury associated with the transport of individuals by use of a qualified biologist and by relocating individuals just outside of the construction area. The potential risks of relocation of tiger salamanders include the spread of disease, outbreeding depression, maladaptation, and disruptions to the existing population (Shaffer *et al.* unpublished). These risks outweigh the potential benefits for relocation of individuals from the construction area to existing or created ponds on the adjacent PHLF parcels. Created sites adjacent to occupied habitat are likely be colonized naturally over a few years if there are no barriers to animal movement (Shaffer *et al.* unpublished). The proposed new ponds (GR1, GR2, EV1, and SH1) are close enough that they could be colonized naturally by the salamander.

Failure to adequately revegetate the disturbed areas with appropriate locally collected native vegetation likely would facilitate the invasion and establishment by plant and animal species that are not native to the area. Non-native plants and animals may reduce habitat quality for the California tiger salamanders and reduce the productivity or the local carrying capacity for these species. A problematic species within the range of the California tiger salamander is the yellow star thistle (*Centaurea melitensis*). Dense stands of this plant can form along roadsides and then spread into adjacent habitat. This plant displaces native vegetation, competes with native plants for resources, and it may be difficult for California tiger salamanders to move through dense stands due to the thistle's numerous sharp spines. Other exotic species that may disperse along disturbed areas and invade adjacent California tiger salamander habitats include mustards (*Brassica* species) and Russian thistle (*Salsola tragus*).

The Southern Hills Parcel, Pond 5 Buffer Parcel, Eastern Valley Parcel, Griffith Ranch Parcel, and the Eastern Hills Parcel will benefit tiger salamanders by protecting their upland and breeding habitat in the region. The Eastern Valley Parcel, Pond 5 Buffer Parcel, and the Southern Hills Parcel have existing tiger salamander breeding ponds (Pond 2, 6, 3, 5 and 7). The Southern Hills Parcel, Pond 5 Buffer Parcel, Eastern Valley Parcel, Griffith Ranch Parcel, and the Eastern Hills Parcel will protect upland tiger salamander habitat. The four ponds to be created (GR1, GR2, EV1, and SH1) could be used for breeding by tiger salamanders as well.

Conservancy Fairy Shrimp, Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp

Individual listed crustaceans and their cysts may be directly injured or killed by activities that damage the vernal pools in which they exist. The biota of vernal pools and swales can change when the hydrologic regime is altered and small changes can have a deleterious effect on entire populations of vernal pool crustaceans (Bauder 1986, 1987). Survival of aquatic organisms like vernal pool fairy shrimp, vernal pool tadpole shrimp, and Conservancy fairy shrimp are directly linked to the water regime of their habitat (Zedler 1987). Therefore, construction near vernal pool areas will, at times, result in the decline of local sub-populations of vernal pool organisms, including these three listed species.

Listed crustaceans could be affected by the removal of fill and the creation of swales/channels on the Director's Guild Parcel. Surveys of ponds on the other parcels and the Phase II expansion site did not find any of these listed crustaceans. On the Director's Guild Parcel, the creation of 0.77 acre of swales/channels and the removal of 0.42 acre of fill within the playa pool would temporarily affect listed crustaceans and their habitat, but these action would be beneficial in the longterm.

Similar to Contra Costa Goldfields, alterations to surface and subsurface water flow and alteration of inundation patterns, increases in erosion and sedimentation, potential effects to plant pollinators, changes in land use patterns (i.e., urbanization) as a result of the expansion and construction all have the potential to affect vernal pool crustaceans.

Any decrease in the duration of inundation of vernal pool habitat can affect the reproductive success of species present, including listed crustaceans. Erosion and sedimentation associated with the fill removal and swale/channel creation can alter vernal pool habitat through the transport and deposition of sediments into these areas, thereby altering the depth, temperature, and water quality of a pool or complex.

The ground disturbing activities associated with the proposed project are expected to result in increases in erosion and sedimentation. Sedimentation in pools supporting listed crustaceans may result in decreased cyst viability, decreased hatching success, and decreased survivorship among early life history stages, thereby reducing the number of mature adults in future wet seasons.

None of the listed vernal pool crustaceans were observed in the Phase II Expansion Area during protocol-level surveys for these species, but the impacted ponds may be considered habitat for these species. Effects to listed crustaceans on the Director's Guild Parcel will be minimized by working during the dry season when vernal pools are typically dry and creating more aquatic habitat for these species on the Director's Guild, Griffith Ranch, and Southern Hills Parcels.

<u>Vernal Pool Fairy Shrimp and Vernal Pool Tadpole Shrimp Critical Habitat</u>

The proposed action is not expected to appreciably diminish the value of the critical habitat for the vernal pool fairy shrimp or the vernal pool tadpole shrimp, or prevent the critical habitats from sustaining its role in the conservation and recovery of these two species. Construction of the Phase II Expansion will permanently destroy 167.63 acres of vernal pool fairy critical habitat within Unit 16A; effects represent 1.33 percent of Unit 16 and 0.073 percent of all critical habitat for the vernal pool fairy shrimp. Construction of the Phase II Expansion will destroy 167.63 acre of habitat for vernal pool tadpole shrimp within critical habitat Unit 11 D; effects represent 1.33 percent of Unit 11 and 0.078 percent of all critical habitat for the vernal pool tadpole shrimp. No vernal pool fairy shrimp or vernal pool tadpole shrimp have been observed during surveys of the Phase II Expansion area. The creation of ponds, seasonal wetlands, and swales/channels will replace 8.07 acres of upland habitat with aquatic habitat. These new wetlands could potentially become inhabited by these listed shrimp. The restoration of the Director's Guild Parcel playa pool will also increase aquatic habitat for these species. Construction will not significantly interfere with the current capability of the critical habitat to satisfy essential requirements of the species. Constituent elements for the vernal pool fairy shrimp and vernal pool tadpole shrimp will stay intact in the remainder of these units during and after project completion and will continue to provide associated upland habitat. Effects to this habitat will also be minimized through PHLF's purchase of 1.9 acres of created seasonal wetlands credits, 1.0 acres of created seasonal ponds credits, 1.1 acres of preserved seasonal ponds credits, 1.0 acres of preserved/enhanced stream channel credits and their long-term management and monitoring and an endowment.

Conservancy Fairy Shrimp Critical Habitat

The proposed action is not expected to appreciably diminish the value of critical habitat for the Conservancy fairy shrimp, or prevent the critical habitat from sustaining its role in the conservation and recovery of the species. The Griffith Ranch and Director's Guild Parcel are both in Conservancy fairy shrimp critical habitat. The proposed project will directly affect 7.02 acres of habitat for Conservancy fairy shrimp within critical habitat Unit 3 due to the swale/channel, seasonal wetland, and pond creation. The effects represent 0.16 percent of Unit 3 and 0.004 percent of all critical habitat for the Conservancy fairy shrimp. The creation of ponds, seasonal wetlands, and swales/channels will replace 7.02 acres of upland habitat with aquatic habitat within this critical habitat unit. These new wetlands could potentially become inhabited by these listed shrimp. Construction will not significantly interfere with the current capability of the critical habitat to satisfy essential requirements of the species. Constituent elements for the Conservancy fairy shrimp will stay intact in the remainder of the unit during and after project completion and will continue to provide associated upland habitat.

Contra Costa Goldfields

Removal of 0.42 acre of previously placed fill from the playa pool and the creation of 0.77 acre of swale/channels on the Director's Guild Parcel will create 1.19 acres of goldfield habitat. Indirect effects include alteration to surface and subsurface water flow and alteration of inundation patterns; potential effects to plant pollinators, the introduction of exotic vegetation. All of these effects have the potential to disturb the reproductive abilities of individual plants and populations by decreasing seed and nutlet production thereby resulting in decreased numbers and/or distribution of plants in subsequent generations.

Similar to shrimp, any decrease in the duration of inundation of vernal pool habitat can affect the reproductive success of species present, including the Contra Costa goldfields. Erosion and sedimentation associated with the fill removal and swale/channel creation can alter vernal pool habitat through the transport and deposition of sediments into these areas, thereby altering the depth, temperature, and water quality of a pool or complex.

There is an increased risk of introducing weedy, non-native plants into the playa pool and swales both during and after construction due to soil disturbance and the vegetation disturbance associated with the use of heavy equipment. Many non-native plants can out-compete native vegetation, thereby reducing the reproductive success of the natives, such as Contra Costa goldfields. In extreme cases, entire areas can be permanently devoid of native vegetation as a result of non-native introductions.

Effects to Contra Costa goldfields on the Director's Guild Parcel will be minimized by fencing off the Contra Costa goldfields area to prevent trampling of plants, or disturbance of soil, during construction activities.

Contra Costa Goldfields Critical Habitat

The proposed action is not expected to appreciably diminish the value of critical habitat for the Contra Costa goldfields, or prevent the critical habitat from sustaining its role in the conservation and recovery of the species. The proposed action will enhance Contra Costa goldfield critical habitat on the Griffith Ranch and Director's Guild Parcels. The proposed project will directly affect 7.02 acres of habitat for Contra Costa goldfields within critical habitat Unit 4C due to the swale/channel, seasonal wetland, and pond creation. The effects represent 0.16 percent of Unit 4C and 0.048 percent of all critical habitat for the Contra Costa goldfields. The proposed project area has been previously disturbed and the habitat value has diminished, thus the project will not significantly interfere with the current capability of the critical habitat to satisfy essential requirements of the species. Primary constituent elements for the remainder of the critical habitat unit for Contra Costa goldfields will remain intact during and after project completion, and will continue to provide suitable habitat.

Habitat Protection

The conservation measures will improve and create habitat for these listed species on habitat adjacent to the Project Area. The Conservation Parcels will preserve 963.28 acres of habitat for all of these listed species: 863.14 acres of tiger salamander upland habitat will be preserved; 4.73 acres of tiger salamander breeding habitat will be preserved; 1.78 acres of tiger salamander breeding habitat will be created; 65.12 acres of seasonal wetlands for Conservancy fairy shrimp, vernal pool tadpole shrimp, vernal pool fairy shrimp, and Contra Costa goldfields will be preserved; 4.49 acres of seasonal wetlands for Conservancy fairy shrimp, vernal pool tadpole shrimp, vernal pool fairy shrimp, and Contra Costa goldfields will be created; 1.48 acres of swale/channel habitat for Conservancy fairy shrimp, vernal pool tadpole shrimp, vernal pool fairy shrimp, and Contra Costa goldfields will be preserved; and 1.80 acres of swale/channel habitat for Conservancy fairy shrimp, vernal pool tadpole shrimp, vernal pool fairy shrimp, and Contra Costa goldfields will be created. PHLF has also purchased 1.9 acres of created seasonal wetlands credits, 1.0 acres of created seasonal ponds credits, 1.1 acres of preserved seasonal ponds credits, 1.0 acres of preserved/enhanced stream channel credits and their long-term management and monitoring and an endowment from Wetland Resources LLC.

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. Future Federal actions unrelated to the proposed action are not considered in this section, because they require separate consultation pursuant to section 7 of the Act.

The global average temperature has risen by approximately 0.6 degrees Celsius during the 20th Century (IPPC 2001, 2007; Adger *et al.* 2007). There is an international scientific consensus that most of the warming observed has been caused by human activities (IPPC 2001, 2007; Adger *et al.* 2007), and that it is "very likely" that it is largely due to manmade emissions of carbon dioxide and other greenhouse gases (Adger *et al.* 2007). Ongoing climate change (Anonymous 2007; Inkley *et al.* 2004; Adger *et al.* 2007; Kanter 2007) likely imperils the tiger salamander, vernal pool tadpole shrimp, vernal pool fairy shrimp, Conservancy fairy shrimp, and Contra Costa goldfields and the resources necessary for their survival. Since climate change threatens to disrupt annual weather patterns, it may result in a loss of their habitats and/or prey, and/or increased numbers of their predators, parasites, and diseases. Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat.

Conclusion

After reviewing the current status of these species, the environmental baseline for the action area, the effects of the proposed action and the cumulative effects, it is the Service's biological opinion that the proposed project is not likely to jeopardize the continued existence of the California tiger salamander, Conservancy fairy shrimp, vernal pool tadpole shrimp, vernal pool fairy shrimp, and Contra Costa goldfields. As proposed, the project will destroy critical habitat for the vernal pool fairy shrimp and vernal pool tadpole shrimp, The proposed project will not adversely modify critical habitat for the Conservancy fairy shrimp and Contra Costa goldfields because these effects are anticipated to be of a temporary nature and will be beneficial in the longterm by creating more aquatic habitat for these species.

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. The Service defines harass 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 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 under the Act, provided such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be implemented by the Corps so they become binding conditions of project authorization for the exemption under 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity that is covered by this incidental take statement. If the Corps (1) fails to adhere to the terms and conditions of the incidental take statement through enforceable terms, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of 7(o)(2) may lapse.

Sections 7(b)(4) and 7(o)(2) of the Act generally do not apply to listed plant species. However, protection of listed plants is provided to the extent that the Act prohibits the removal and reduction to possession of federally listed plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of listed plants on non-Federal areas in violation of State law or regulation or in the course of any violation of a State criminal trespass law.

Amount or Extent of Take

The Service expects that incidental take of the California tiger salamander, vernal pool fairy shrimp, vernal pool tadpole shrimp, and Conservancy fairy shrimp may occur during this action. The extent of the take will be difficult to detect or quantify because of the ecology and biology of these species. Additionally, their size and cryptic nature makes the finding of a dead specimen unlikely. Seasonal population fluctuations also may mask the ability to determine the exact extent of take.

Due to the difficulty in quantifying the number of listed crustaceans 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 playa pool (vernal pool crustacean habitat) that will become unsuitable for vernal pool crustaceans due to direct or indirect effects as a result of the action. Therefore, the Service estimates that the proposed action will result in the take of all vernal pool fairy shrimp, vernal pool tadpole shrimp, and Conservancy fairy shrimp inhabiting 1.19 acres of playa pool habitat identified in the action area on the Director's Guild Parcel. Anticipated take is expected to be in the form of harm, harassment, capture, injury, and mortality from habitat loss and modification, construction related disturbance, and reduced fitness.

Due to the difficulty in quantifying the number of tiger salamanders 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 ponds (tiger salamander breeding habitat) and number of acres of upland habitat (tiger salamander upland habitat) that will become unsuitable for tiger salamanders due to direct or indirect effects as a result of the action. Therefore, the Service estimates that the proposed action will result in the take of all California tiger salamanders inhabiting or utilizing 165.16 acres of appropriate upland dispersal habitat (direct) from the Phase II expansion area, 1.86 acres of tiger salamander wetland dispersal habitat (direct) from the Phase II expansion area, 0.61 acre of stock pond breeding habitat (direct) from the Phase II expansion area, 6.88 acres uplands (direct) from the creation of ponds, seasonal wetlands, and swales/channels on the Southern Hills, Griffith Ranch, and Eastern Valley Parcels, 0.011 acre uplands (direct) from the installation of new power poles on the Eastern Valley and Hill Parcels, and 0.029 acre uplands (direct) from the installation of a buried pipeline and 4 troughs on the Southern Hills Parcel. Anticipated take is expected to be in the form of harm, harassment, capture, injury, and mortality from habitat loss and modification, construction related disturbance, increased predation, reduced fitness, and increased vehicular traffic.

Upon implementation of the following reasonable and prudent measures, incidental take associated with the Proposed Potrero Hills Landfill Phase II Expansion Project on the listed crustaceans and tiger salamander, in the form of harm, harassment, injury, or mortality from habitat loss or degradation will become exempt from the prohibitions described under section 9 of the Act.

Effect of the Take

The Service has determined that the level of anticipated take is not likely to result in jeopardy to the tiger salamander, vernal pool fairy shrimp, vernal pool tadpole shrimp, Conservancy fairy shrimp, or Contra Costa goldfields and their critical habitat.

Reasonable and Prudent Measure

The Service believes the following reasonable and prudent measure is necessary and appropriate to minimize the effects of take on listed species:

> Minimize the potential for harm, harassment, injury, and mortality to the tiger salamander, vernal pool fairy shrimp, vernal pool tadpole shrimp, and Conservancy fairy shrimp resulting from project related activities by implementation of the conservation measures as described in this biological opinion.

Terms and Conditions

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

The following Terms and Conditions implement the Reasonable and Prudent Measure:

1. The Corps will incorporate the requirement to fully implement all the proposed conservation measures as a condition of its permit to the applicant for this project.

2. The Corps will also condition its permit to require compliance with the reporting requirements of this Biological Opinion, including a post construction report outlining how the Conservation Measures were implemented for this project.

3. If requested, before, during, or after completion of ground breaking at the project site, the Corps through the applicant shall allow immediate access by the Service and CDFG, and/or their agents, to the project site.

Reporting Requirements

Injured California tiger salamanders must be cared for by a licensed veterinarian or other qualified person such as the Service and CDFG-approved biologist. Dead individuals of the tiger salamander, vernal pool fairy shrimp, vernal pool tadpole shrimp, and Conservancy fairy shrimp must be placed in a zip-lock® plastic bag containing a piece of paper with the date, time, and location where the animal was found, and who found it written in permanent ink, and then placed in a freezer located in a secure location. The Service and the California Department of Fish and Game must be notified within one (1) working day of the discovery of death or injury to a tiger salamander, vernal pool fairy shrimp, vernal pool tadpole shrimp, or Conservancy fairy shrimp that occurs due to project related activities or if any are observed at the project site. Notification must include the date, time, and location of the incident or of the finding of a dead or injured animal clearly indicated on a USGS 7.5 minute quadrangle and other maps at a finer scale, as requested by the Service, and any other pertinent information. The Service contacts are Division Chief, Endangered Species Program at the Sacramento Fish and Wildlife Office at telephone (916) 414-6600, and Resident Agent-in-Charge of the Service's Law Enforcement Division at telephone (916) 414-6660. The California Department of Fish and Game contact is Liam Davis at telephone (707) 944-5529 and for immediate assistance is State Dispatch at (916) 445-0045.

Sightings of any listed or sensitive animal species should be reported to the California Natural Diversity Database of the California Department of Fish and Game. A copy of the reporting form and a topographic map clearly marked with the location the animals were observed also should be provided to the Service.

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.

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 conservation recommendations. We propose the following conservation recommendations:

1. The Corps should assist the Service in implementing recovery actions identified in the *Recovery Plan Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005).

2. Encourage or require the use of appropriate California native species in revegetation and habitat enhancement efforts associated with projects authorized by the Corps.

3. Sightings of any listed or sensitive species should be reported to the California Natural Diversity Database of the California Department of Fish and Game. A copy of the reporting form and a topographic map clearly marked with the location the species were observed also should be provided to the Service.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the Proposed Potrero Hills Landfill Phase II Expansion Project, Solano 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 our response on the Proposed Potrero Hills Landfill Phase II Expansion Project, please contact Andrew Raabe or Ryan Olah at the letterhead address, telephone (916) 414-6600, or electronic mail at Andrew_Raabe@fws.gov or Ryan_Olah@fws.gov.

Sincerely,

Susan K. Moore

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Field Supervisor

cc:
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