FOR CONTRACT NO: 04-4S3704
PROJECT ID: 0400001230

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NON-STORM WATER INFORMATION PACKAGE

ROUTE: 04-Ala-580-PM 11.1

United States Department of the Interior

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

In Reply Refer To:
81420-2008-F-0487-R002-1

MAY 18 2012

Ms. Melanie Brent, Office Chief
Caltrans District 4 Environmental Analysis
California Department of Transportation
P.O. Box 23660
Oakland, California 94623-0660

Subject: Acknowledgement of Change in Construction Schedule for the Tangent Soldier Pile Wall near Arroyo Seco Creek of the Interstate 580 Westbound High Occupancy Vehicle Lane Project, Alameda County, California (Caltrans EA 4S370)

Dear Ms. Brent:

This letter is an acknowledgement of the California Department of Transportation's (Caltrans) letter dated April 17, 2012, requesting approval of a delay in the anticipated start of construction for the installation of a tangent soldier pile wall to prevent further erosion from occurring along the southern streambank of Arroyo Seco Creek for the Interstate 580 (I-580) Westbound High Occupancy Vehicle (HOV) Lane Project located in Alameda County, California. Your letter indicated that construction was delayed beyond the August 2011 start date as evaluated in the October 14, 2010, amendment (Service File No.: 81420-2008-F-0487-R002) to the biological opinion issued on September 17, 2009 (Service File No.: 81420-2008-F-0487-2). Your letter is requesting the start date be changed from August 2011 to April 2013. The Service acknowledges this change and understands that the proposed project activities remain unchanged and are consistent with the activities described in the October 14, 2010, amendment and September 17, 2009, biological opinion.

If you have questions concerning this letter in reference to the proposed I-580 Westbound HOV Lane Project, please contact Jerry Roe or Ryan Olah, Coast Bay/Forest Foothills Division Chief, at the letterhead address or at (916) 414-6600.

Sincerely,

E. Tattersall

for Susan K. Moore
Field Supervisor

United States Department of the Interior

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

In Reply Refer To:
81420-2008-F-0487-2

SEP 17 2009

Mr. Jim Richards
Attn: Robert Atanasio
Office of Biological Sciences and Permits
California Department of Transportation
P.O. Box 23660
Oakland, California 94623-0660

Subject: Biological Opinion on the Effects of the Proposed Interstate 580 Westbound HOV Lane Project, Alameda County, California (Caltrans EA 290820) on the Threatened Vernal Pool Fairy Shrimp, Threatened California Red-Legged Frog, Threatened Central Valley DPS California Tiger Salamander, and Endangered San Joaquin Kit Fox

Dear Mr. Richards:

This letter responds to a letter from the California Department of Transportation (Caltrans), dated July 3, 2008, which requested formal consultation for the proposed Interstate 580 Westbound HOV Lane Project, Alameda County, California. Your letter was received by the U.S. Fish and Wildlife Service (Service) on July 22, 2008. This document represents the Service's Biological Opinion on the effects of the project on the threatened vernal pool fairy shrimp (*Branchinecta lynchi*), threatened California red-legged frog (*Rana aurora draytonii*), threatened Central Valley DPS California tiger salamander (*Ambystoma californiense*), and San Joaquin kit fox (*Vulpes macrotis mutica*) under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (Act).

The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) legislation (23 U.S.C. 327) allows the Secretary of the U.S. Department of Transportation (USDOT) acting through the Federal Highway Administration (FHWA) to establish a Surface Transportation Project Delivery Pilot Program, whereby a State may assume the FHWA responsibilities under the National Environmental Policy Act (NEPA) for environmental review, agency consultation and other actions pertaining to the review or approval of a specific project. Caltrans assumed these responsibilities for the FHWA on July 1, 2007 through a Memorandum of Understanding (MOU) within the State of California: http://www.dot.ca.gov/ser/downloads/MOUs/nepa_delegation/sec6005mou.pdf.

Based on the information provided in the July 2008 biological assessment, the March 27, 2008 site visit, and the response to comments letter from Caltrans dated March 17, 2009 and accompanying exhibits, the Service concurs with the likely to adversely affect determination for the San Joaquin kit fox, California red-legged frog, California tiger salamander, and vernal pool

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fairy shrimp (the determination of the latter was changed by Caltrans to likely to adversely affect based on information provided in the biological assessment and the recommendation made by the Service in the letter to Caltrans dated February 18, 2009). Caltrans determined that the proposed project would have no effect on the designated critical habitat for the vernal pool fairy shrimp. Vernal pool fairy shrimp critical habitat Unit 19C occurs within the action area near the eastern most portion of the project alignment. Caltrans determined that the portion of critical habitat Unit 19C within the action area does not support the primary constituent elements defined by the Service (Service 2005b, 2006a).

This biological opinion is based on: (1) the *Biological Assessment: Route I-580 Westbound HOV Lane* dated July 2008; (2) letter from Caltrans to the Service dated March 17, 2009 and accompanying exhibits; (3) site visits conducted by the Service and Caltrans on October 17, 2007 and March 27, 2008; (4) miscellaneous correspondence and electronic mail concerning the proposed action between Caltrans and the Service; and (5) other information available to the Service.

Consultation History

October 17, 2007	John Cleckler, Maral Kasparian and Steve Pagliugtli of the Service attended a meeting with Melanie Brent of Caltrans, Ray Akkawi and Hank Haugse of the Alameda County Congestion Management Agency, and the consultant team to review the project. A field visit was conducted following the meeting. Topics discussed included the project overview, which species to include in the Biological Assessment, construction methods, project timeline, and project approach and methodology.
December 10, 2007	The Service received correspondence from Caltrans dated December 7, 2007 and habitat assessments for the California tiger salamander, vernal pool fairy shrimp, California red-legged frog, and San Joaquin kit fox.
March 6, 2008	Jerry Roe, Chris Nagano and Maral Kasparian of the Service attended a meeting with Margaret Gabil and Robert Atanasio of Caltrans, Ray Akkawi and Hank Haugse of the Alameda County Congestion Management Agency, and the consultant team to review the revised project, biological findings, effects determination, project timing and scheduling, and avoidance and minimization measures.
March 27, 2008	Jerry Roe and John Cleckler of the Service, Margaret Gabil and Robert Atanasio of Caltrans, Ray Akkawi and Hank Haugse of the Alameda County Congestion Management Agency, and the consultant team conducted a field visit to view the project alignment and areas where listed species would be affected. The Service advised Caltrans to account for all project effects to listed species as temporary versus permanent and not to count those effects covered in other Biological Opinions for overlapping projects – I-580 Eastbound HOV, I-580/Isabel Avenue Interchange, I-580/ Portola Avenue Interchange, and I-580/Fallon Road Interchange. The

	Service requested a more detailed analysis of construction activities at the creek crossings, culvert extension, and Seasonal Wetland 1.
July 22, 2008	The Service received a letter from Caltrans dated July 3, 2008 requesting the initiation of formal consultation for the vernal pool fairy shrimp, California tiger salamander, California red-legged frog and San Joaquin kit fox. Correspondence included a biological assessment and habitat assessments for each of the four species.
February 18, 2009	The Service issued a 30 day letter to Caltrans requesting clarification and additional information from Caltrans to adequately review the determination of the effects of the project on listed species and designated critical habitats.
March 18, 2009	The Serviced received a letter from Caltrans dated March 17, 2009 responding to the 30-day letter requesting clarification and additional information from Caltrans. Detailed engineering exhibits of aspects of the project affecting listed species accompanied the letter.
March 25, 2009	The Service received the Initial Study, Proposed Mitigated Negative Declaration/Environmental Assessment dated March 2009.
August 13, 2009	The Service issued the draft biological opinion to Caltrans.
September 14, 2009	The Service received comments from Caltrans on the draft biological opinion and requested the final biological opinion be issued with the requested change with regards to limiting work within vernal pool fairy shrimp habitat to the dry season once the top six inches of soil have completely dried. The change was agreeable to the Service and was incorporated into the final biological opinion.
September 15, 2009	Conference call between the Service, Caltrans, Alameda County Congestion Management Agency, and BKF to discuss the intent and clarify the compensation requirements.
October 18, 2007 - September 15, 2009	Electronic and phone correspondence between Robert Atanasio and Margaret Gabil of Caltrans, and John Cleckler and Jerry Roe of the Service.

BIOLOGICAL OPINION

Description of the Proposed Action

The following project description, inclusive of the proposed compensation and proposed conservation measures, was provided by Caltrans and is an excerpt from the July 2008 Biological Assessment with minor modifications for reasons of clarity and accuracy provided by the Service. A comprehensive description of the project is available in the Initial Study/ Environmental Assessment (Caltrans 2009).

Project History

The goal of the I-580 Westbound High Occupancy Vehicle (HOV) Project (Project) is to reduce peak-period congestion and delay, encourage high-occupancy vehicles and mass transit, and support regional air quality attainment goals.

Rapid development on the outer edges of the San Francisco Bay Area, in particular eastern Alameda County, Contra Costa County, the Central Valley, and Santa Clara County has resulted in a sharp increase in regional traffic within the past decade. Traffic delays have steadily grown worse along the I-580 corridor and around the I-580/I-680 interchange. An increase of 43 percent in the average daily traffic volumes along both eastbound and westbound I-580 is projected by 2025.

Within the project limits, the majority of trips are made in single-occupancy vehicles. The high number of single-occupancy vehicle trips greatly increases traffic congestion as well as air pollutants. The U.S. Environmental Protection Agency (EPA) has classified the San Francisco Bay Area as a moderate non-attainment area for ozone. The greatest number of air quality standard ozone violations occurs at the Livermore monitoring station within the project limits. In the summer, motor vehicles are the leading producers of ozone within the Bay Area. Similarly, vehicle trips during the winter months steeply increase carbon monoxide levels.

Project Description

In cooperation with Caltrans, Alameda County Congestion Management Agency (ACCMA), proposes to construct a westbound HOV lane along a 13.1-mile segment of I-580, beginning west of the Greenville Road undercrossing (post mile 8.29) and ending east of the San Ramon Blvd/Foothill Road overcrossing (post mile 21.43), in eastern Alameda County. The project is located within the Dublin, Livermore, and Altamont 7.5-minute Quadrangles.

Other elements of the project include:

- Constructing an auxiliary lane along I-580 westbound between the Vasco Road and First Street Interchanges
- Constructing an auxiliary lane along I-580 westbound between the First Street and North Livermore Interchanges
- Constructing 3,800 feet of auxiliary lane along I-580 westbound from the North Livermore Avenue on-ramp
- Constructing 4,800 feet of auxiliary lane along I-580 westbound from the Airway Boulevard on-ramp
- Widening the North Livermore Avenue undercrossing (Bridge No. 33-0153) in both eastbound and westbound directions
- Widening two existing crossings of the Arroyo Las Positas (Bridge No. 33-0085 and Bridge No. 33-0203) at both the westbound and eastbound directions
- Widening the existing crossing of the Arroyo Las Positas (Bridge No. 33-0012) in the westbound direction only

- Widening the existing bridge crossing over Tassajara Creek (Bridge No. 33-0015) in the median section and both the eastbound and westbound directions
- Widening the Dougherty Drive undercrossing (Bridge No. 33-0150L) in the westbound direction
- Extending the existing box culvert at Arroyo Seco Creek along the westbound direction
- Constructing a westbound express bus ramp connection from the westbound HOV lane to the East Dublin/Pleasanton BART Station
- Constructing HOV bypass lanes at the eastbound and westbound on-ramps at Greenville Road, Vasco Road, First Street, and North Livermore Avenue; and the westbound on-ramp at Airway Boulevard
- Modify the ramp noses at interchange areas to accommodate for auxiliary lane, HOV bypass lane and shoulder widening

Biological Study Area (BSA)

The area studied and addressed in the biological assessment encompasses the I-580 Caltrans right-of-way (ROW), as well as temporary construction easements and proposed additional right-of-way. The proposed right-of-way would be acquired to accommodate the project along the I-580 corridor between Greenville Road and San Ramon Road/Foothill Road within the project limits. The BSA captures the limits of the area in which project activities would occur. Project activities would not occur outside the limits of the BSA.

The Isabel Avenue, Portola Avenue and Fallon Road Interchange Projects are proposed to occur within the I-580 HOV Lane project limits. The area of effect for each of these projects is clearly depicted in the Appendix A (Resource Maps) of the biological assessment and is indicated as "work done by others." The BSA overlaps and intersects some portions of the areas of effect as shown on Mapsheets 6, 9 and 10 included in the Resource Maps (Appendix A) of the biological assessment. This biological assessment does not include project effects in the areas where overlap occurs.

Construction Activities

Construction of the HOV lane involves paving additional surface primarily on the northern edge of the current configuration adjacent to the westbound I-580 outside travel lanes to accommodate an additional lane. In general, the existing roadway within the project limits will be widened to accommodate the HOV lane and a new shoulder, which will be up to 14 ft wide. Newly paved areas will be graded at a 1.5-3% slope trending to a 5% slope in the shoulder of westbound I-580 to properly drain water from the roadway surface. An example cross section of the configuration of the proposed changes to the lanes and shoulders within the project limits is depicted in Figure 1-3 of the biological assessment.

Wherever possible, inside and outside shoulders will be constructed to 14 ft in width; however, shoulder widths will vary along ramps and in other segments where the westbound lanes of I-580 are constrained on either or both sides. The project proposes construction of a 4 ft wide area between Hacienda and I-680 to separate the existing mixed-flow lanes from the proposed HOV lane and shoulder beyond.

The proposed project will cross over the following drainages and creeks:

- Alamo Creek
- Tassajara Creek
- Cottonwood Creek
- Collier Canyon Creek
- Arroyo Las Positas Creek
- Arroyo Seco Creek

Two types of creek crossing structures are present within the project limits. At these creek crossings the roadway is supported either by continuous concrete tee-beam bridge structures, or large diameter double or triple reinforced concrete box culverts, typically in a paired configuration.

Tee-Beam Bridge Structures

In general, the project would widen the existing creek crossing structures to accommodate the additional width needed for the HOV lanes in both the westbound and eastbound directions. The configuration and bridge type would be consistent with the existing conditions at the creek crossings. The project would only increase the width of the bridges along both the north and south edges of these structures. An example cross-section depicting the proposed work at the creek crossings is included in Figure 1-4 of the biological assessment. Extending the width of bridges that are supported by columns will require driving piles into the substrate within the BSA and construction of a bridge deck above. The limits of the work areas at each creek location are clearly depicted in the map sheets included in Appendix A (Resource Maps) of the biological assessment.

Reinforced Concrete Box (RCB) Culverts

Extending the existing box culverts would require construction of concrete forms and support structures contiguous with existing concrete box culvert structures. The triple box culvert at Arroyo Seco will be extended by approximately seven feet. Construction work will include demolishing the existing head walls, wingwalls and apron slab, extending the existing 40-foot wide box, and constructing new head walls, wingwalls and apron slab. It is anticipated that the construction will be performed in two stages. Upstream, water will be diverted into one exterior cell and the area immediately in front of the outfall apron slabs will be filled with a self-compacting material to create a flat and dry work area for small equipment. One half of the new RCB will be constructed while the water is diverted through the opposite cell. Once one side is constructed, the process will be repeated on the other side of the RCB. Site access will be provided from the existing BSA. An example plan view drawing of construction at the Arroyo Seco RCB is included in Figure 1-5 of the biological assessment.

Project Reaches

Construction of the westbound HOV lane will occur within discrete segments to avoid the temporary closure of consecutive interchanges. The description below is for roadway and bridge work construction. Although identified separately, the roadway and bridge construction may be done simultaneously with no restriction to one construction before the other. Construction will be completed in the following sequence:

The general order of work for freeway widening is as follows:

- Relocate underground and above ground utilities (gas lines, electrical lines, water lines and sanitary sewage) within the construction area (6 months)
- Clear grub area to be graded. Remove existing pavements, structures, and utilities within construction zone (4 months)
- Trench excavate, shore, and install underground utilities including culverts, storm drainage and conduits. Cut and backfill as required (6 months)
- Grade roadway to final subgrade. Place subbase and base courses (3 months)
- Place asphalt/concrete (AC) pavement and striping (4 months)
- Place new signs and remove temporary pavements and signs (4 months)
- Complete landscaping and fencing. Clean up site and remove equipment and remaining materials (6 months)

The general order of work for bridge widening is as follows (2 years):

- Excavate and shore for abutment and bent foundations
- Drive piles for abutment and bent foundations
- Pour concrete abutment and bent foundations
- Form and pour concrete abutment and bents
- Backfill at foundation locations
- Erect falsework for superstructure construction
- Install cast-in-place concrete girders or slabs
- Form and pour concrete barriers
- Install signs and fencing
- Restore site around abutments and bents. Clean up and remove equipment and remaining materials

Equipment

For informational purposes the typical equipment expected to be used during construction is described below. Actual equipment to be used will ultimately be selected by the contractor and will be chosen based on site-specific considerations.

Clear and Grub
- Excavator
- Backhoe
- Heavy Duty Dump Trucks

Ramp Demolition
- Front Loader
- Hoe Ram
- Heavy Duty Dump Trucks

Retaining Walls
- Backhoe
- Bormag BMP 851
- Concrete Pump
- Compressor
- Ready Mix Trucks
- Medium Duty Dump Trucks
- Flatbed Trucks

Earthwork
- Excavator

- Backhoe
- Front Loader
- Dozer/Trencher/Heavy Duty Dump Trucks

Paving
- Grader
- Water Truck
- Vibratory Roller
- Compactor
- Concrete Pump
- Ready Mix Trucks
- Asphalt Paver
- Asphalt Roller
- Sweeper

- Medium Duty Dump Trucks
- Flatbed Trucks

Structures
- Excavator
- Backhoe
- Soil Compactor
- Crane
- Pile Driver
- Concrete Pump
- Compressor
- Bridge Deck Paver
- Flatbed Truck
- Medium Duty Dump Trucks
- Ready Mix Trucks

Proposed Compensation

To offset permanent effects to vernal pool fairy shrimp, California red-legged frog, California tiger salamander, and San Joaquin kit fox, suitable habitat for each species, or suitable multi-species habitat in coordination with the Service, will be created, restored, or set aside in perpetuity (Table 1). Alternatively, credits will be purchased at a Service-approved conservation bank.

Table 1: Proposed Compensation for Project Effects

SPECIES	I-580 WB HOV PROJECT EFFECTS	ESTIMATED EFFECTS COMPENSATED BY OTHER PROJECTS[1]	TOTAL COMPENSATION FOR I-580 WB HOV
Vernal pool fairy shrimp	0.013 ac	n/a	0.013 ac
California red-legged frog	20.09 ac	1.13 ac	18.96 ac
California tiger salamander	8.56 ac	0.04 ac	8.52 ac
San Joaquin kit fox	21.21 ac	2.336 ac	18.874 ac

Proposed Conservation Measures

In accordance with the NEPA and the Act, the project applicant has included conservation measures to minimize the potential effects on special-status species, including federal and state-listed species. Several project-wide avoidance and minimization measures (AMMs) have been included as part of the proposed project specifically to protect potential habitat for listed species

[1] Refers to the affected portion of federally listed species habitat that overlaps with other Caltrans projects for which Section 7 consultation has been completed; the effects acreages have been subsequently removed from the total area calculations. These projects include I-580 Eastbound HOV (Service File #1-1-07-F-0273), I-580/Fallon Road Interchange (Service File # 1-1-07-F-0257), and I-580/Isabel Avenue Interchange (Service File # 1-1-07-F-0280).

in, and immediately adjacent to, the BSA. Following direction from the biologists during a November 14, 2007 meeting, engineers shifted the project design slightly to reduce effects to listed species. The minutes from this meeting are included in Appendix J (Avoidance and Minimization Measures (Team Meeting Summary) of the biological assessment. Following this meeting, biologists identified AMMs, which will be implemented when construction activities could potentially affect known or suitable habitat for listed species. In addition to the general AMMs provided below, species-specific and habitat-specific AMMs have also been developed for the proposed project. These specific AMMs will minimize direct and indirect effects on individual species and/or suitable habitat for these species.

General Conservation Measures

1. General AMM – 1: Establish Environmentally Sensitive Areas

   Environmentally Sensitive Areas (ESAs) will be established along the outside perimeter where sensitive habitats occur adjacent to the BSA. Orange barrier fencing will be constructed along the work area perimeter adjacent to sensitive habitats to clearly delineate the extent of the area where construction may occur. The ESAs will prevent construction encroachment into sensitive habitats supporting special-status species including creek habitats located directly adjacent but not within the BSA. The specific locations of wetlands and waters of the state directly adjacent to the BSA will be verified by the U.S. Army Corps of Engineers and the boundaries of the adjacent wetlands where they intersect the project area shall be transcribed from the jurisdictional determination map onto construction drawings for the proposed project. The construction specifications shall contain clear language that prohibits construction-related activities, vehicle operation, material and equipment storage, and other surface-disturbing activities within ESAs. In addition, hydrological features (i.e., topographic depressions, roadside ditches, culverts, etc.) outside of the BSA will not be manipulated (i.e., re-routed, dredged, filled, graded, etc.). This will reduce potential effects to wetlands outside of the BSA that may be hydrologically connected to wetlands within the BSA.

2. General AMM – 2: Implement Erosion Control Measures and Storm Water Pollution Prevent Plans

   Storm Water Pollution Prevention Plans (SWPPP) and erosion control best management practices (BMPs) will be developed and implemented to minimize any wind or water-related erosion (Appendix B of the biological assessment). The SWPPP will provide guidance for design staff to include provisions in construction contracts to include measures to protect sensitive areas and to prevent and minimize storm water and non-storm water discharges. Protective measures will include, at a minimum:

   a. No discharge of pollutants from vehicle and equipment cleaning is allowed into any storm drains or water courses.

   b. Vehicle and equipment fueling and maintenance operations must be at least 50 ft away from water courses, except at established commercial gas stations or established vehicle maintenance facility.

   c. Concrete wastes are collected in washouts and water from curing operations is collected and disposed of and not allowed into water courses.

d. Dust control will be implemented, including use of water trucks and tackifiers to control dust in excavation and fill areas, covering temporary access road entrances and exits with rock (rocking), and covering temporary stockpiles when weather conditions require.

e. Coir rolls or straw wattles will be installed along or at the base of slopes during construction to capture sediment.

f. Protection of graded areas from erosion using a combination of silt fences, fiber rolls along toes of slopes or along edges of designated staging areas, and erosion control netting (such as jute or coir) as appropriate on sloped areas.

g. Incorporate the use of bio-filtration strips and swales to receive storm water discharges from the highway, or other impervious surfaces.

3. General AMM – 3: Replant/Re-Seed Disturbed Areas

All slopes or unpaved areas affected by the proposed project will be re-seeded with native grasses and shrubs to stabilize the slopes and bare ground against erosion. Following construction, native (and non-native if appropriate) plant species will be installed at the disturbed area. Furthermore, native trees removed during project construction shall be re-established within the BSA at the replacement rate specified by CDFG, or applicable tree ordinances, typically at ratios ranging from 1:1 to 3:1 (mitigation to effect) depending on the quality of the habitat impacted.

4. General AMM– 4: Provide Environmental Awareness Training

Before the onset of construction activities, a qualified biologist will conduct an education program for all construction personnel. At a minimum the training will include a description of vernal pool fairy shrimp, California red-legged frog, California tiger salamander, and San Joaquin kit fox and their habitats; the occurrence of these species within the BSA; an explanation of the status of these species and protection under the ESA; the measures that are being implemented to conserve the species and their habitats as they relate to the work site; and the work site boundaries within which construction may occur. A fact sheet conveying this information will be prepared to construction and other project personnel who may enter the BSA. Upon completion of the program, personnel will sign a form stating that they attended the program and understand all the avoidance and minimization measures and implications of ESA.

5. General AMM – 5: Restrictions on Construction Activities

a. A speed limit of 15 miles per hour (mph) in the BSA in unpaved areas will be enforced to reduce dust and excessive soil disturbance.

b. Temporary construction easements, which will be used for construction access, staging, storage, and parking areas, will be located outside of any designated ESAs. Access routes and the number and size of staging and work areas will be limited to the minimum necessary to construct the proposed project. Routes and boundaries of roadwork will be clearly marked prior to initiating construction or grading.

c. All food and food-related trash items will be enclosed in sealed trash containers and removed completely from the site at the end of each day.

d. No pets from project personnel will be allowed anywhere in the BSA during construction.

e. All equipment will be maintained such that there will be no leaks of automotive fluids such as gasoline, oils or solvents and a Spill Response Plan will be prepared. Hazardous materials such as fuels, oils, solvents, etc. will be stored in sealable containers in a designated location that is at least 100 ft from wetlands and aquatic habitats.

f. Servicing of vehicles and construction equipment including fueling, cleaning, and maintenance will occur at least 100 ft from any aquatic habitat unless separated by topographic or drainage barrier or unless it is an already existing gas station. Staging areas may occur closer to the project activities as required.

g. Work within an inundated drainage, channel, or within Seasonal Wetland 1 or in-water work, will be conducted outside the Central and Northern California rainy season of October 15 through April 15. Any work on bridges and/or culverts in the several creeks within the BSA that require work within the main channel of a creek will occur between April 15 and October 15.

h. Construction in an inundated drainage will be conducted with coffer dams to isolate dewatered areas from active channel habitats.

6. General AMM – 6: Install Exclusion Netting Under All Bridges

Migratory birds and bats could nest and/or roost under the bridges at the creek crossings through out the BSA. Although no federally listed birds or bats have the potential to occur in the BSA, occupied nests and eggs of native migratory birds are protected by California Fish and Game Code Sections 3503 and 3503.5 and the federal Migratory Bird Treaty Act (MBTA).

a. Exclusion methods will be used to preclude the birds from nesting. Such methods could include the use of netting, which will be placed under the bridge structures prior to the nesting season (at the end of January) to prevent nesting and roosting in the construction areas

b. Additionally, consistent scraping of nests during nest construction and prior to February 1 may deter the birds from nesting in the BSA.

Vernal Pool Fairy Shrimp Protective Measures

7. Vernal Pool Fairy Shrimp AMM -1: Silt fences will be installed on the slopes adjacent to the construction activities to prevent silt and run-off from entering Seasonal Wetland 1. The silt fences will be monitored and maintained in place during construction.

8. Vernal Pool Fairy Shrimp AMM -2: Construction activities located at Seasonal Wetland 1 will be restricted to the dry season between April 15 and October 15. Ground disturbing

activities will not start until the top six-inches of soils in the work area are no longer saturated.

California Red-Legged Frog Protective Measures

9. California Red-Legged Frog AMM -1: A Service-approved biologist will be designated for the project and will be on-site during initial grading when it occurs within California red-legged frog upland habitat within the BSA. An on-site biologist will be present during work conducted in suitable aquatic habitat mapped within the BSA. The resident engineer will halt work and immediately contact the approved biologist and the Service in the event that a California red-legged frog enters the construction zone. The resident engineer will suspend all construction activities in the immediate construction zone until the animal leaves the site voluntarily or is removed by the biologist to a release site using Service-approved transportation techniques. No project activities will occur outside the delineated project construction area.

10. California Red-Legged Frog AMM -2: Temporary erosion control consisting of applying erosion control materials, such as straw, and stabilizing emulsion, silt fencing, jute wattles, etc. will be applied to embankment slopes and excavation slopes. Plastic mono-filament netting (erosion control matting) or similar material will not be used within the BSA because California red-legged frogs may become entangled or trapped in it. Acceptable substitutes include coconut coir matting or tackified hydroseeding compounds.

11. California Red-Legged Frog AMM -3: Temporary drainage inlet protection including placement of erosion control around the drainage inlets, e.g. erosion control blankets, rocks, fiber rolls, gravel-filled bags, silt fencing, form barriers, and sediment filter bags, depending on the conditions at the time of construction, as determined by the contractor and as approved by the engineer.

12. California Red-Legged Frog AMM -4: Temporary concrete washout facilities for waste management and material pollution for concrete operations, to eliminate discharge into storm drain systems or water courses. Temporary concrete washout facilities may consist of a plastic liner, gravel-filled bags, and straw bales as determined by the contractor with approval from the engineer.

13. California Red-Legged Frog AMM -5: Temporary silt fencing - a temporary linear barrier for sediment control to intercept and detain sediment in storm water runoff from unprotected areas at construction sites adjacent to California red-legged frog aquatic habitat.

14. California Red-Legged Frog AMM -6: If requested, before, during, or upon completion of ground breaking and construction activities, Caltrans shall allow access by Service and/or CDFG personnel to the BSA to inspect project effects to the California red-legged frog, and their habitats.

15. California Red-Legged Frog AMM -7: Prior to any ground disturbance within mapped California red-legged frog suitable aquatic habitat within the BSA, pre-construction surveys will be conducted by a Service-approved biologist for the California red-legged

frog. These surveys will consist of walking surveys of the project limits and adjacent areas accessible to the public to determine presence of the species.

16. California Red-Legged Frog AMM -8: Only Service-approved biologist(s) who are familiar with the biology and ecology of the California red-legged frog will capture or handle the species. The Service-approved biologist(s) will use nets or their bare hands to capture the California red-legged frog at the project site.

17. California Red-Legged Frog AMM -9: Biologist will take precautions to prevent introduction of amphibian diseases to the action area by disinfecting equipment and clothing as directed by the Service.

18. California Red-Legged Frog AMM -10: To prevent inadvertent entrapment of California red-legged frogs during construction, all excavated, steep-walled holes or trenches more than 2 ft deep will be covered at the close of each working day by plywood or similar materials, or provided with one or more escape ramps constructed of earth fill or wooden planks. Before such holes or trenches are filled they must be thoroughly inspected for trapped animals. If at any time a trapped listed animal is discovered, the on-site biologist will immediately place escape ramps or other appropriate structures to allow the animal to escape, or the Service and/or CDFG will be contacted by telephone for guidance. The Service will be notified of the incident by telephone and email within one working day.

19. California Red-Legged Frog AMM -11: Seasonal avoidance: If possible, grading and clearing in California red-legged frog suitable aquatic habitat mapped in the BSA will limited to April 15 through October 15. If grading is scheduled to occur before April 15 or after October 15 barrier fencing will be constructed along the edges of the construction area. The barrier fencing prevents individuals of the species from traveling into the BSA from suitable habitats located adjacent to the project area.

20. California Red-Legged Frog AMM -12: A temporary barrier, consisting of silt fencing or plywood, at least 36 inches in height, which is buried six inches in the ground, will be placed immediately outside the construction fencing in the creek work areas mapped as suitable California red-legged frog habitat within the BSA. This measure is intended to prevent frogs that may potentially be present in off-site seasonal wetland habitat from entering the project site. Wire mesh screens will be placed over culverts to prevent frogs from entering the site. While construction is underway in suitable aquatic habitat, this barrier will be inspected daily and maintained to ensure that it is functional.

21. California Red-Legged Frog AMM -13: Upon completion of the proposed project, all California red-legged frog habitat subject to temporary ground disturbances, including storage and staging areas, temporary roads etc. will be re-contoured, if appropriate, and revegetated with seeds and/or cuttings of appropriate plant species to promote restoration of the area to pre-project conditions.

22. California Red-Legged Frog AMM -14: Caltrans will submit a post-construction compliance report prepared by the on-site biologist to the Service within forty working days following project completion or within sixty calendar days of any break in construction activity lasting more than forty working days.

California Tiger Salamander Protective Measures

23. California Tiger Salamander AMM -1: A qualified biological monitor will be on site during initial site grading of areas where California tiger salamander habitat is mapped within the BSA. The biological monitor will conduct a suitable training session for all construction workers before work is started on the project. The training will address special-status species and AMMs. To prevent inadvertent entrapment California tiger salamander during construction, all excavated, steep-walled holes or trenches more than 2 ft deep will be covered at the close of each working day by plywood or similar materials, or provided with one or more escape ramps constructed of earth fill or wooden planks. Before such holes or trenches are filled they must be thoroughly inspected for trapped animals. If at any time a trapped listed animal is discovered, the on-site biologist will immediately place escape ramps or other appropriate structures to allow the animal to escape, or the Service and/or CDFG will be contacted by telephone for guidance. The Service will be notified of the incident by telephone and email within one working day. If possible, within the portion of the BSA mapped as suitable upland California tiger salamander habitat grading and clearing will be conducted between April 15 and October 15 of any given year. If grading cannot be confined to the dry season which is defined as the period of April 15 and October 15, the following additional measures shall be imposed:

    a. Exclusion Fencing. If possible, grading and clearing in California tiger salamander suitable aquatic habitat mapped in the BSA will limited to April 15 through October 15. If grading is scheduled to occur before April 15 or after October 15 barrier fencing will be constructed along the edges of the construction area. The barrier fencing prevents individuals of the species from traveling into the BSA from suitable habitats located adjacent to the project area. A temporary barrier consisting of silt fencing, plywood, or suitable material at least 35 inches high that is buried 6 inches in the ground or sealed in a like manner to prevent incursion under the fence will be placed immediately outside the construction fencing barriers to prevent California tiger salamander potentially occurring off-site from entering the project site. A qualified biologist will inspect this barrier when it is constructed to verify that this requirement is met.

    b. The exclusion fence/barrier placed within the California tiger salamander upland habitat areas will be inspected during rain events. During this inspection the biologist will also inspect any subterranean refugia within the BSA to detect California tiger salamander that may be onsite.

24. California Tiger Salamander AMM -2: Construction activities located at the California tiger salamander breeding habitat located at Seasonal Wetland 1 will be restricted to the dry season between April 15 and October 15.

San Joaquin Kit Fox Protective Measures

25. San Joaquin Kit Fox AMM -1: Service-approved biologist will be designated for the project and will be on-call during all construction activities that occur within the BSA. Qualifications of the biologist(s) must be presented to the Service for review and written approval prior to ground-breaking at the project site. The biologist will perform pre-construction surveys, surveys for dens, and pipe and culvert searches.

26. San Joaquin Kit Fox AMM -2: The resident engineer will halt work and immediately contact the approved on-call biologist and the Service in the event that a San Joaquin kit fox enter the construction zone. The resident engineer will suspend all construction activities in the immediate construction zone until the animal leaves the site voluntarily or is removed by the biologist to a release site using Service-approved transportation techniques.

27. San Joaquin Kit Fox AMM -3: To prevent inadvertent entrapment San Joaquin kit fox during construction, all excavated, steep-walled holes or trenches more than 0.61 m (2 ft) deep will be covered at the close of each working day by plywood or similar materials, or provided with one or more escape ramps constructed of earth fill or wooden planks. Before such holes or trenches are filled they must be thoroughly inspected for trapped animals. If at any time a trapped listed animal is discovered, the on-call biologist will immediately be contacted and requested to place escape ramps or other appropriate structures to allow the animal to escape or to relocate the animal to a Service-approved location. The Service will be notified of the incident by telephone and email within one working day.

28. San Joaquin Kit Fox AMM -4: To eliminate an attraction to predators of the San Joaquin kit fox, all food-related trash items such as wrappers, cans, bottles, and food scraps will be disposed of in closed containers and removed at least once a day from the entire project site.

29. San Joaquin Kit Fox AMM -5: To avoid injury or death of the San Joaquin kit fox, no firearms will be allowed on the project site except for those carried by authorized security personnel, or local, State or Federal law enforcement officials.

30. San Joaquin Kit Fox AMM -6: To prevent harassment, injury or mortality of San Joaquin kit fox or destruction of their dens or burrows by dogs or cats, no canine or feline pets will be permitted on the project site.

31. San Joaquin Kit Fox AMM -7: Use of pesticides will be restricted in the areas where ground squirrel burrows have been mapped. Appendix H of the biological assessment includes maps of the portions of the BSA in which ground squirrel burrows were found.

32. San Joaquin Kit Fox AMM -8: To the maximum extent possible, nighttime construction will be minimized.

33. San Joaquin Kit Fox AMM -9: If requested, before, during, or upon completion of ground breaking and construction activates, Caltrans shall allow access by Service and/or CDFG personnel to the project site to inspect project effects to the San Joaquin kit fox, and their habitats.

34. San Joaquin Kit Fox AMM -10: Caltrans will identify and execute the appropriate action(s) regarding notification, buffers, excavation and fill, or seal-off in regards to the San Joaquin kit fox if an occupied natal den is visible or encountered within the BSA.

35. San Joaquin Kit Fox AMM -11: Individuals of the species are attracted to den-like structures such as pipes and may enter stored pipe becoming trapped or injured. All replacement pipes, culverts, or similar structures with a diameter of four inches or greater

that are stored in the action area for one or more overnight periods will be thoroughly inspected for kit foxes before the pipe is subsequently buried, capped, or otherwise moved or used in any way. If a kit fox is discovered inside a pipe, that section of pipe will not be moved until the Service has been consulted by telephone.

36. San Joaquin Kit Fox AMM -12: Upon completion of the proposed project, all San Joaquin kit fox habitat subject to temporary ground disturbances, including storage and staging areas, temporary roads etc. will be re-contoured, if appropriate, and revegetated with seeds and/or cuttings of appropriate plant species to promote restoration of the area to pre-project conditions.

37. San Joaquin Kit Fox AMM -13: Injured San Joaquin kit fox will be cared for by a licensed veterinarian or other qualified person such as the on-site biologist; dead individuals will be preserved according to standard museum techniques and held in a secure location. The Service and the CDFG will be notified within one working day of the discovery of death or injury to San Joaquin kit fox.

38. San Joaquin Kit Fox AMM -14: A post-construction compliance report prepared by the on-call biologist will be provided to the Service within forty (40) working days following project completion or within sixty calendar days of any break in construction activity lasting more than forty (40) working days.

Analytical Framework for Jeopardy

Jeopardy Determinations

In accordance with policy and regulation, the jeopardy analysis in this Biological Opinion relies on four components: (1) the *Status of the Species* and (2) *Environmental Baseline*, which evaluates the vernal pool fairy shrimp, California red-legged frog, California tiger salamander, and San Joaquin kit fox range-wide conditions, the factors responsible for that condition, and their survival and recovery needs; and evaluates the condition of these 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 four animals; (3) 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 (4) *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 vernal pool fairy shrimp, California red-legged frog, California tiger salamander, and San Joaquin kit fox 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 four 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 vernal pool fairy shrimp, California red-legged frog, Central Valley DPS California tiger salamander, and San Joaquin kit fox and the role of the action area in the survival and recovery of these four 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.

Action Area

The action area is defined in 50 CFR § 402.02, as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." For the proposed action, the Service considers the action area to comprise a 13.1-mi segment of I-580 from west of the Greenville Road undercrossing (post mile 8.29) to east of the San Ramon Boulevard/Foothill Road overcrossing (post mile 21.43), in eastern Alameda County. The action area encompasses the project footprint, equipment staging areas, access routes, Caltrans Right-of-Way (ROW) limits, project-specific construction easements, and adjacent lands that will be subjected to noise, light, and vibration disturbance.

Status of the Species and Environmental Baseline

Vernal Pool Fairy Shrimp

Listing Status: *The vernal pool fairy shrimp was listed as threatened on* September 19, 1994 (Service 1994). A five-year review was published on October 9, 2007 that recommended the species remain listed as threatened (Service 2007). Critical Habitat was designated for this species on August 6, 2003 (Service 2003a), revised on August 11, 2005 (Service 2005b), and species unit designations were published on February 10, 2006 (Service 2006a). A recovery plan was published for the vernal pool fairy shrimp on December 15, 2005 (Service 2005a).

Description and Natural History: The vernal pool fairy shrimp (*Branchinecta lynchi*) is a small freshwater crustacean (0.12 to 1.5 inches long) belonging to an ancient order of branchiopods, the Anostraca. Like other anostracans, it has stalked compound eyes and eleven pairs of phyllopods (swimming legs that also function as gills). The vernal pool fairy shrimp is genetically distinct from other Branchinecta species, and is distinguished by the morphology of the male's second antenna and the female's third thoracic segment (on the middle part of its body) (Belk and Fugate 2000). The species was first collected between 1874 and 1941, when it was described incorrectly as *Branchinecta colorodensis* (Linder 1941 in Service 2005a). Its identity as a separate species was resolved only in 1990 (Eng et al. 1990). Subsequent genetic analysis has confirmed that the vernal pool fairy shrimp is a distinct species (Fugate 1992).

The vernal pool fairy shrimp has an ephemeral life cycle and exists only in cool-water vernal pools or vernal pool-like habitats; the species does not occur in riverine, marine, or other permanent bodies of water. Roughly 80 percent of observations of the shrimp are from vernal pools (Helm 1998; Helm and Vollmar 2002). Like most other fairy shrimps, the vernal pool fairy shrimp lacks any substantial anti-predator defenses and does not persist in waters with fish (King et al. 1996; Eriksen and Belk 1999). Vernal pool fairy shrimp feed on algae, bacteria, protozoa, rotifers, and detritus by filtering food out of the water column using wave-like motions of their phyllopods. The second pair of antennae in fairy shrimp adult males are greatly enlarged and specialized for clasping the females during copulation. The females carry 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. When the temporary pools dry, offspring persist in suspended development as desiccation-resistant embryos (commonly called cysts) in the pool substrate until the return of winter rains and appropriate temperatures allow some of the cysts to hatch (Eriksen and Belk 1999). The dormant egg, or cyst, can withstand fire (Wells et al. 1997), freezing, anoxic conditions, and temperatures near boiling (Carlisle 1968) without damage to the embryo. The cyst wall is not 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).

Individuals hatch from cysts during cold-weather winter storms; they require water temperatures of 50°F or lower to hatch (Helm 1998; Eriksen and Belk 1999). When the pools refill in the same or subsequent seasons, some, but not all, of the cysts may hatch. The cyst bank in the soil may therefore be comprised of cysts from several years of breeding (Donald 1983). The early stages of the fairy shrimp develop rapidly into adults; however, the time to maturity and reproduction is temperature dependent, varying between 18 days and 147 days, with a mean of 39.7 days (Helm 1998). The vernal pool fairy shrimp can mature quickly, allowing populations to persist in short-lived shallow pools (Simovich et al. 1992). In pools that persist for several weeks to a few months, fairy shrimp may produce multiple generations during a single season (Helm 1998; Gallagher 1996).

Distribution: The vernal pool fairy shrimp is endemic to California and the Agate Desert of southern Oregon. It has the widest geographic range of the federally-listed vernal pool crustaceans, but it is seldom abundant where found, especially where it co-occurs with other species (Eng et al. 1990; Eriksen and Belk 1999). The range of the species extends from disjunct locations in Riverside County and the Coast Ranges, north through Central Valley grasslands to Tehama County, and then to a disjunct area of remnant vernal pool habitat in the Agate Desert of Oregon. The five disjunct populations are located near Soda Lake in San Luis Obispo County; in the mountain grasslands of northern Santa Barbara County; on the Santa Rosa Plateau in Riverside County; near Rancho California in Riverside County; and 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.

In general, the vernal pool fairy shrimp has a sporadic distribution within the vernal pool complexes, with most pools being uninhabited by the species (59 FR 48136). Helm (1998) found vernal pool fairy shrimp in 16.3 percent of pools sampled across 27 counties, while Sugnet and Associates, in 1993, found the species in 5 percent of 3,092 locations sampled over much of the range (Service 2005a). In several areas, the shrimp has been found more commonly during surveys. For example, in a survey of a Pacific Gas & Electric (PG&E) pipeline right-of-way, the shrimp was found in the majority of pools sampled in 6 of 14 sites along a transect from Shasta to Solano County; all six locales where the shrimp was found were in Tehama County (King et al. 1996). In one relatively small locale, the 2000-acre University of California (UC) Merced Planning Area, the species is documented from almost 90 percent of complex pools, although abundance of shrimp within pools is not recorded (Jones and Stokes 2007). The species is typically associated with smaller and shallower vernal pools (typically about 6 inches deep) that have relatively short periods of inundation (Helm 1998) and relatively low to moderate total dissolved solids (TDS) and alkalinity (Eriksen and Belk 1999); however, at the southernmost extremes of the range, the shrimp is present only in large, deep pools.

Dispersal: Both flooding and the movement of wildlife within vernal pool complexes allow fairy shrimp to disperse between individual pools. 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 (J. King, pers. comm., 1995). This dispersal is currently 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 may now be the primary dispersal agents for vernal pool fairy shrimp. The eggs of this branchiopod are either ingested (Krapu 1974; Swanson et al. 1974; Driver 1981; Ahl 1991) and/or adhere to the legs and feathers where they are transported to new habitats. Cysts may also be dispersed by a number of other species, such as salamanders, toads, cattle, and humans (Eriksen and Belk 1999).

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. These movement patterns, as well as genetic evidence, indicate that vernal pool fairy shrimp populations are defined by entire vernal pool complexes, rather than individual pools (King et al. 1996; Fugate 1998). 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 Ecology and Adaptations: Vernal pool habitats form in depressions above an impervious substrate layer, or claypan/duripan, in alluvial fans and terraces that are known primarily from the eastern side of the Central Valley of California (Vollmar 2002). Due to local topography and geology, the depressions are part of an undulating landscape, where soil mounds are interspersed with basins, swales, and drainages (Nikiforoff 1941, Holland and Jain 1978). 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). 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 that is washed into the pool from adjacent uplands, and these nutrients provide the foundation for the vernal pool aquatic community food chain.

The thermal and chemical properties of vernal pool waters are two of the primary factors affecting the distributions of specific fairy shrimp species (including the vernal pool fairy shrimp), or their appearance from year to year. Different species may appear in pools from one year to the next, depending on whether the pools fill at a different time of the year. Based on hatching and life history requirements, species may also appear in succession during one season as conditions change within the pool (Simovich and Fugate 1992; Eriksen and Belk 1999). In years with warm winter rains, vernal pool fairy shrimp apparently do not hatch in at least a portion of their range (C. Witham, CNPS, pers. comm., 2007 in Service 2005a). Immature and adult shrimp are known to die off when water temperatures rise to approximately 75°F (Helm 1998). In years with low amounts of precipitation or atypical timing of precipitation, (or in substandard habitat) vernal pool species may die off before reproducing (Eriksen and Belk 1999). In some cases vernal pool fairy shrimp will cease to be found in pools where they were formerly found (Jones and Stokes 2005; Eriksen and Belk 1999). Long-distance dispersal of anostracan cysts is thought to be enabled by waterfowl and other migratory birds that ingest cysts, and by animals that provide for movement of mud and cysts in feathers, fur, and hooves (see authors cited in Fugate 1992; see also Eriksen and Belk 1999; Figuerola and Green 2002). Because the cysts are dispersed by other animals, they can be dispersed into locations that will never provide suitable habitat, or into waters that provide conditions allowing individuals to hatch in some years, but where conditions are not suitable for maintaining viable populations.

Vernal pools 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 1978). 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. They 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.

Reasons for Decline and Threats to Survival: The genetic characteristics of these species, as well as ecological conditions, such as watershed continuity, indicate that populations of vernal pool crustaceans 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. The pools and, in some cases, pool complexes supporting these species may be small. Human-caused and unforeseen natural catastrophic events such as long-term drought, non-native predators, off-road vehicles, pollution, creation of berms, and urban development, threaten their extirpation at some sites. Vernal pool fairy shrimp continue to be threatened by all of the factors which led to the original listing of this species, primarily habitat loss through agricultural conversion and urbanization.

Historically, vernal pools and vernal pool complexes occurred extensively throughout the Central Valley; outside of the Central Valley they occur in disjunct locations limited in area and extent in California and Oregon comprising 17 distinct regions based primarily on endemic species and secondarily on soils and geomorphology (Keeler-Wolf et al. 1998). The East Bay and Livermore Valley areas have undergone intensive urban development in recent years (California Department of Conservation 1996, 1998, 2000, 2002). The total human population of the counties in the Bay Area region increased by approximately 17 percent between 1990 and 2000 (4.5 million to 5.3 million people) (California Department of Finance 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).

Status of the Species: The lands north of the City of Livermore are located within the Livermore Vernal Pool Region (Vernal Pool Region 5) and the Altamont Hills core area, comprising 5 distinct subareas (Service 2005a). The recovery criteria for the Altamont Hills core area for vernal pool fairy shrimp is to delist the species, protect 85% of its habitat rangewide, and reintroduce species in areas supporting suitable habitat in which status surveys indicate the species has been extirpated (Service 2005a).

In the Livermore Vernal Pool Region, the vernal pool fairy shrimp has been found in the Springtown area and the vicinity of Byron Airport in Alameda and Contra Costa counties, respectively, (Keeler-Wolf et al. 1998, Service 2005a). Within this region vernal pool fairy shrimp occur primarily on private land; however, occurrences have also been reported on land owned by Contra Costa County and the City of Livermore (Service 2005a). Vernal pools within this region were historically widespread throughout the valley; however, human activity has reduced their numbers to a great extent (Keeler-Wolf et al. 1998). Pool types within this region are characterized as Northern Claypan and Northern Hardpan vernal pools (Keeler-Wolf et al. 1998). Within this region the vernal pool fairy shrimp is threatened by development, including expansion of the Byron Airport (Service 2005a). 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). During the 1980s and 1990s, vernal pools were lost at an annual rate of 1.1 percent in Alameda County (Holland 1998).

Vernal pool fairy shrimp have been reported from three locations within Alameda County located approximately 1.4 to 3.5 miles north to northeast from Seasonal Wetland 1. In 1996, Sarah Lynch reported vernal pool fairy shrimp (Occ. #142) within a series of ponds and vernal swales associated with the Stonechase project approximately ½-mile east of the Hartford Avenue/North Livermore Avenue intersection north of I-580 (CDFG 2009). Between 1991 and 1993 (Occ. #99), Stanford University researchers collected vernal pool fairy shrimp from venal pools within the Springtown Natural Communities Reserve owned by the City of Livermore; Dr. Richard Arnold conducted follow-up surveys in 2000 and documented the absence of this species in the southwest portion of Springtown (CDFG 2009). In 2005 (Occ. #411), Raymond White reported vernal pool fairy shrimp in 13 separate vernal pools on property immediately south of Frick Lake east of Laughlin Road; the property comprised a heavily grazed pasture containing a vernal pool complex (CDFG 2009). In preparing the Biological Assessment, all three occurrence locations were visited by the biological consultant to the extent possible based on access limitations; all habitats were said to be easily identifiable and distinct based on topography and characteristic vegetative cover (Caltrans 2008).

Environmental Baseline

The Biological Assessment (Caltrans 2008) identifies Seasonal Wetland 1 as potential habitat for vernal pool fairy shrimp; however, the wetland does not exhibit the features characteristic of vernal pools or swales within northern Alameda County. Seasonal Wetland 1 is a remnant oxbow of Arroyo Las Positas Creek, which was likely isolated during the construction of I-580. The wetland is approximately 0.613-acre in size, is situated within non-native annual grasslands north of I-580, and is largely absent of emergent vegetation. All but 0.013-acre of the wetland is subject to cattle grazing, the latter of which is protected by a barbed-wire fence running along the Caltrans right-of-way. This 0.013-acre area supports a small but dense stand of emergent rushes. The supporting watershed for Seasonal Wetland 1 comprises contiguous lands north of I-580 that drain south toward the interstate. The 0.013-acre portion of the wetland proposed for removal is the southernmost extent of the wetland. This area contains two cross drain culverts that convey water under I-580 into Arroyo Las Positas Creek.

Although it is unknown whether vernal pool fairy shrimp currently occupy Seasonal Wetland 1, its proximity to occupied habitat, i.e. 1.4 miles to the north (CNDDB Occ. #142), impervious soils, seasonal hydroperiod, topographical features and vegetative characteristics provide the necessary habitat attributes to support one or all of this species' life history stages. Furthermore, wading birds, mammals and livestock that visit this and other nearby wetlands, ponds and swales to forage or drink water, act as vectors to transport cysts or adults from one pond to another through their feces or on their feathers, fur, legs or hooves. For these reasons, the Service has determined there is a reasonable potential for vernal pool fairy shrimp to inhabit Seasonal Wetland 1within the action area.

California Red-legged Frog

Listing Status: The California red-legged frog was listed as a threatened species on May 23, 1996 (Service 1996). Critical Habitat was designated for this species on April 13, 2006 (Service 2006b) and a proposed revision was published on September 16, 2008 (Service 2008). A recovery plan was published for the California red-legged frog on September 12, 2002 (Service 2002).

Description: The California red-legged frog is the largest native frog in the western United States (Wright and Wright 1949), ranging from 1.5 to 5.1 inches (3.81 to 12.95 centimeters) in length (Stebbins 2003). The abdomen and hind legs of adults are largely red, while the back is characterized by small black flecks and larger irregular dark blotches with indistinct outlines on a brown, gray, olive, or reddish background color. Dorsal spots usually have light centers (Stebbins 2003), and dorsolateral folds are prominent on the back. Larvae (tadpoles) range from 0.6 to 3.1 inches (1.52 to 7.87 centimeters) in length, and the background color of the body is dark brown and yellow with darker spots (Storer 1925).

Distribution: The historic range of the red-legged frog extended coastally from the vicinity of Elk Creek in Mendocino County, California, and inland from the vicinity of Redding, Shasta County, California, southward to northwestern Baja California, Mexico (Fellers 2005; Jennings and Hayes 1985; Hayes and Krempels 1986). The red-legged frog was historically documented in 46 counties but the taxa now remains in 238 streams or drainages within 23 counties, representing a loss of 70 percent of its former range (Service 2002). Red-legged frogs are still locally abundant within portions of the San Francisco Bay area and the central coast. Within the remaining distribution of the species, only isolated populations have been documented in the Sierra Nevada, northern Coast, and northern Transverse Ranges. The species is believed to be extirpated from the southern Transverse and Peninsular ranges, but is still present in Baja California, Mexico (CDFG 2009).

Status and Natural History: California red-legged frogs predominately inhabit permanent water sources such as streams, lakes, marshes, natural and manmade ponds, and ephemeral drainages in valley bottoms and foothills up to 1,500 meters in elevation (Jennings and Hayes 1994, Bulger et al. 2003, Stebbins 2003). However, red-legged frogs also have been found in ephemeral creeks and drainages and in ponds that may or may not have riparian vegetation. California red-legged frogs breed between November and April in still or slow-moving water at least 2½ feet (0.7 meters) in depth with emergent vegetation, such as cattails (*Typha* spp.), tules (*Scirpus* spp.) or overhanging willows (*Salix* spp.) (Hayes and Jennings 1988). Red-legged frogs have paired vocal sacs and vocalize in air (Hayes and Krempels 1986). Female frogs deposit egg masses on emergent vegetation so that the egg mass floats on or near the surface of the water (Hayes and Miyamoto 1984). Red-legged frogs breed from November through March with earlier breeding records occurring in southern localities (Storer 1925). Individuals occurring in coastal drainages are active year-round (Jennings et al. 1992), whereas those found in interior sites are normally less active during the cold season.

During other parts of the year, habitat includes nearly any area within 1-2 miles (1.6-3.2 kilometers) of a breeding site that stays moist and cool through the summer (Fellers 2005). According to Fellers (2005), this can include vegetated areas with coyote brush (*Baccharis pilularis*), California blackberry thickets (*Rubus ursinus*), and root masses associated with willow (*Salix species*) and California bay (*Umbellularis californica*) trees. Sometimes the non-breeding habitat used by red-legged frogs is extremely limited in size. For example, non-breeding red-legged frogs have been found in a 6-foot (1.8-meter) wide coyote brush thicket growing along a tiny intermittent creek surrounded by heavily grazed grassland (Fellers 2005). Sheltering habitat for red-legged frogs is potentially all aquatic, riparian, and upland areas within the range of the species and includes any landscape features that provide cover, such as existing animal burrows, boulders or rocks, organic debris such as downed trees or logs, and industrial debris. Agricultural features such as drains, watering troughs, spring boxes, abandoned sheds, or hay stacks may also be used. Incised stream channels with portions narrower and depths greater than 18 inches (45.7 centimeters) also may provide important summer sheltering habitat. Accessibility to sheltering habitat is essential for the survival of red-legged frogs within a watershed, and can be a factor limiting frog population numbers and survival.

California red-legged frogs do not have a distinct breeding migration (Fellers 2005). Adult frogs are often associated with permanent bodies of water. Some frogs remain at breeding sites all year while others disperse. Dispersal distances are typically less than 0.5 mile (0.8 kilometers), with a few individuals moving up to 1-2 miles (1.6-3.2 kilometers) (Fellers 2005). Movements are typically along riparian corridors, but some individuals, especially on rainy nights, move directly from one site to another through normally inhospitable habitats, such as heavily grazed pastures or oak-grassland savannas (Fellers 2005).

In a study of California red-legged frog terrestrial activity in a mesic area of the Santa Cruz Mountains, Bulger et al. (2003) categorized terrestrial use as migratory and non-migratory. The latter occurred from one to several days and was associated with precipitation events. Migratory movements were characterized as the movement between aquatic sites and were most often associated with breeding activities. Bulger reported that non-migrating frogs typically stayed within 200 feet (60 meters) of aquatic habitat 90% of the time and were most often associated with dense vegetative cover, i.e. California blackberry, poison oak and coyote brush. Dispersing frogs in northern Santa Cruz County traveled distances from 0.25 miles (0.4 kilometers) to more than 2 miles (3.2 kilometers) without apparent regard to topography, vegetation type, or riparian corridors (Bulger et al. 2003).

In a study of California red-legged frog terrestrial activity in a xeric environment, Tatarian (2008) noted that a 57% majority of frogs fitted with radio transmitters in the Round Valley study area in eastern Contra Costa County stayed at their breeding pools, whereas 43% moved into adjacent upland habitat or to other aquatic sites. This study reported a peak of seasonal terrestrial movement occurring in the fall months, with movement commencing with the first 0.2 inches (0.5 cm) of precipitation. Movements away from the source pools tapered off into spring. Upland movement activities ranged from 3 to 233 feet (1 to 71 m), averaging 80 feet (24.38 m), and were associated with a variety of refugia including grass thatch, crevices, cow hoof prints, ground squirrel burrows at the bases of trees or rocks, logs, and a downed barn door; others were associated with upland sites lacking refugia (Tatarian 2008). The majority of terrestrial movements lasted from 1 to 4 days; however, one adult female was reported to remain in upland habitat for 50 days (Tatarian 2008). Uplands closer to aquatic sites were used more often and frog refugia were more commonly associated with areas exhibiting higher object cover, e.g. woody debris, rocks, and vegetative cover. Subterranean cover was not significantly different between occupied upland habitat and non-occupied upland habitat.

California red-legged frogs are often prolific breeders, laying their eggs during or shortly after large rainfall events in late winter and early spring (Hayes and Miyamoto 1984). Egg masses containing 2,000 to 5,000 eggs are attached to vegetation below the surface and hatch after 6 to 14 days (Storer 1925, Jennings and Hayes 1994). In coastal lagoons, the most significant mortality factor in the pre-hatching stage is water salinity (Jennings et al. 1992). Eggs exposed to salinity levels greater than 4.5 parts per thousand results in 100 percent mortality (Jennings and Hayes 1990). Increased siltation during the breeding season can cause asphyxiation of eggs and small larvae. Larvae undergo metamorphosis 3½ to 7 months following hatching and reach sexual maturity 2 to 3 years of age (Storer 1925; Wright and Wright 1949; Jennings and Hayes 1985, 1990, 1994). Of the various life stages, larvae probably experience the highest mortality rates, with less than 1 percent of eggs laid reaching metamorphosis (Jennings et al. 1992). Sexual maturity normally is reached at 3 to 4 years of age (Storer 1925; Jennings and Hayes 1985). Red-legged frogs may live 8 to 10 years (Jennings et al. 1992). Populations of red-legged frogs fluctuate from year to year. When conditions are favorable red-legged frogs can experience extremely high rates of reproduction and thus produce large numbers of dispersing young and a concomitant increase in the number of occupied sites. In contrast, red-legged frogs may temporarily disappear from an area when conditions are stressful (e.g., drought).

The diet of California red-legged frogs is highly variable and changes with the life history stage. The diet of larval California red-legged frogs is not well studied, but is likely similar to that of other ranid frogs, feeding on algae, diatoms, and detritus by grazing on the surface of rocks and vegetation (Fellers 2005; Kupferberg 1996a, 1996b, 1997). Hayes and Tennant (1985) analyzed the diets of California red-legged frogs from Cañada de la Gaviota in Santa Barbara County during the winter of 1981 and found invertebrates (comprising 42 taxa) to be the most common prey item consumed; however, they speculated that this was opportunistic and varied based on prey availability. They ascertained that larger frogs consumed larger prey and were recorded to have preyed on Pacific tree frogs, three-spined stickleback (*Gasterosteus aculeatus*) and to a limited extent, California mice (*Peromyscus californicus*), which were abundant at the study site (Hayes and Tennant 1985, Fellers 2005). Although larger vertebrate prey was consumed less frequently, it represented over half of the prey mass eaten by larger frogs suggesting that such prey may play an energetically important role in their diets (Hayes and Tennant 1985). Juvenile and subadult/adult frogs varied in their feeding activity periods; juveniles fed for longer periods throughout the day and night, while subadult/adults fed nocturnally (Hayes a0nd Tennant 1985). Juveniles were significantly less successful at capturing prey and all life history stages exhibited poor prey discrimination; feeding on several inanimate objects that moved through their field of view (Hayes and Tennant 1985).

Metapopulation and Patch Dynamics: The direction and type of habitat used by dispersing animals is especially important in fragmented environments (Forys and Humphrey 1996). Models of habitat patch geometry predict that individual animals will exit patches at more "permeable" areas (Buechner 1987; Stamps et al. 1987). A landscape corridor may increase the patch-edge permeability by extending patch habitat (La Polla and Barrett 1993), and allow individuals to move from one patch to another. The geometric and habitat features that constitute a "corridor" must be determined from the perspective of the animal (Forys and Humphrey 1996).

Because their habitats have been fragmented, many endangered and threatened species exist as metapopulations (Verboom and Apeldom 1990; Verboom et al. 1991). A metapopulation is a collection of spatially discrete subpopulations that are connected by the dispersal movements of the individuals (Levins 1970; Hanski 1991). For metapopulations of listed species, a prerequisite to recovery is determining if unoccupied habitat patches are vacant due to the attributes of the habitat patch (food, cover, and patch area) or due to patch context (distance of the patch to other patches and distance of the patch to other features). Subpopulations on patches with higher quality food and cover are more likely to persist because they can support more individuals. Large populations have less of a chance of extinction due to stochastic events (Gilpin and Soule 1986). Similarly, small patches will support fewer individuals, increasing the rate of extinction. Patches that are near occupied patches are more likely to be recolonized when local extinction occurs and may benefit from emigration of individuals via the "rescue" effect (Hanski 1982; Gotelli 1991; Holt 1993; Fahrig and Merriam 1985). For the metapopulation to persist, the rate of patches being colonized must exceed the rate of patches going extinct (Levins 1970). If some subpopulations go extinct regardless of patch context, recovery actions should be placed on patch attributes. Patches could be managed to increase the availability of food and/or cover. Movements and dispersal corridors likely are critical to California red-legged frog population dynamics, particularly because the animals likely currently persist as metapopulations with disjunct population centers. Movement and dispersal corridors are important for alleviating over-crowding and intraspecific competition, and also they are important for facilitating the recolonization of areas where the animal has been extirpated. Movement between population centers maintains gene flow and reduced genetic isolation. Genetically isolated populations are at greater risk of deleterious genetic effects such as inbreeding, genetic drift, and founder effects. The survival of wildlife species in fragmented habitats may ultimately depend on their ability to move among patches to access necessary resources, retain genetic diversity, and maintain reproductive capacity within populations (Hilty and Merenlender 2004; Petit et al. 1995; Buza et al. 2000).

Most metapopulation or meta-population-like models of patchy populations do not directly include the effects of dispersal mortality on population dynamics (Hanski 1994; With and Crist 1995; Lindenmayer and Possingham 1996). Based on these models, it has become a widely held notion that more vagile species have a higher tolerance to habitat loss and fragmentation than less vagile species. But models that include dispersal mortality predict exactly the opposite: more vagile species should be more vulnerable to habitat loss and fragmentation because they are more susceptible to dispersal mortality (Fahrig 1998; Casagrandi and Gatto 1999). This prediction is supported by Gibbs (1998), who examined the presence-absence of five amphibian species across a gradient of habitat loss. He found that species with low dispersal rates are better able than more vagile species to persist in landscapes with low habitat cover. Gibbs (1998) postulated that the land between habitats serves as a demographic "drain" for many amphibians. Furthermore, Bonnet et al. (1999) found that snake species that use frequent long-distance movements have higher mortality rates than do sedentary species.

Threats: Habitat loss, non-native species introduction, and urban encroachment are the primary factors that have adversely affected the red-legged frog throughout its range. Several researchers in central California have noted the decline and eventual local disappearance of California and northern red-legged frogs in systems supporting bullfrogs (Jennings and Hayes 1990; Twedt 1993), red swamp crayfish (*Procambarus clarkii*), signal crayfish (*Pacifastacus leniusculus*), and several species of warm water fish including sunfish (*Lepomis* spp.), goldfish (*Carassius auratus*), common carp (*Cyprinus carpio*), and mosquitofish (*Gambusia affinis*) (Moyle 1976, S. Barry 1992, L. Hunt 1993, Fisher and Schaffer 1996). This has been attributed to predation, competition, and reproduction interference. Twedt (1993) documented bullfrog predation of juvenile northern red-legged frogs (*Rana aurora aurora*), and suggested that bullfrogs could prey on subadult northern red-legged frogs as well. Bullfrogs may also have a competitive advantage over red-legged frogs. For instance, bullfrogs are larger and possess more generalized food habits (Bury and Whelan 1984). In addition, bullfrogs have an extended breeding season (Storer 1933) during which an individual female can produce as many as 20,000 eggs (Emlen 1977). Further more, bullfrog larvae are unpalatable to predatory fish (Kruse and Francis 1977). Bullfrogs also interfere with red-legged frog reproduction. Both California and northern red-legged frogs have been observed in amplexus (mounted on) with both male and female bullfrogs (Jennings and Hayes 1990; Twedt 1993; M. Jennings 1993). Thus bullfrogs are able to prey upon and out-compete red-legged frogs, especially in sub-optimal habitat.

The urbanization of land within and adjacent to red-legged frog habitat has also impacted red-legged frogs. These declines are attributed to channelization of riparian areas, enclosure of the channels by urban development that blocks red-legged frog dispersal, and the introduction of predatory fishes and bullfrogs. This report further identifies the conversion and isolation of perennial pool habitats resulting from urbanization as an ongoing impact to red-legged frogs. Mao et al. (1999 cited in Fellers 2005) reported northern red-legged frogs infected with an iridovirus, which was also presented in sympatric threespine sticklebacks (*Gasterosteus aculeatus*) in northwestern California. Ingles (1932a, 1932b, and 1933 cited in Fellers 2005) reported four species of trematodes from red-legged frogs, but he later synonymized two of them (found them to be the same as the other two).

Diseases may also pose a significant threat though the specific effects of disease on the California red-legged frog are not known. Pathogens are suspected of causing global amphibian declines (Davidson et al. 2003). Chytridiomycosis and ranaviruses are a potential threat to the red-legged frog because these diseases have been found to adversely affect other amphibians, including the listed species (Davidson et al. 2003; Lips et al. 2003). Non-native species, such as bullfrogs and non-native tiger salamanders that live within the range of the California red-legged frog have been identified as potential carriers of these diseases (Garner et al. 2006). 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 the listed species being more susceptible to the effects of disease. Disease will likely become a growing threat because of the relatively small and fragmented remaining California red-legged frog 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.

Negative effects to wildlife populations from roads and pavement may extend some distance from the actual road, as the proposed project. The phenomenon can result from any of the effects already described in this biological opinion, such as vehicle-related mortality, habitat degradation, and invasive exotic species. Forman and Deblinger (1998) described the area affected as the "road effect" zone. Along a 4-lane road in Massachusetts, they determined that this zone extend for an average of approximately 980 feet to either side of the road for an average total zone width of approximately 1970 feet. However, in places they detected an effect greater than 0.6-mile from the road. The "road-zone" effect can also be subtle. Van der Zandt *et al.* (1980) reported that lapwings (*Vanellus vanellus*) and black-tailed godwits (*Limosa limosa*) feeding at 1,575 feet-6,560 feet from roads were disturbed by passing vehicles. The heart rate, metabolic rate and energy expenditure of female bighorn sheep (*Ovis canadensis*) increases near roads (MacArthur et al. 1979). Trombulak and Frossell (2000) described another type of "road-zone' effect due to contaminants. Heavy metal concentrations from vehicle exhaust were greatest within 66 feet of roads, by elevated levels of metals in both soil and plants were detected at 660 feet of roads. The "road-zone" apparently varies with habitat type and traffic volume. Based on responses by birds, Forman (2000) estimated the effect zone along primary roads of 1,000 feet in woodlands, 1,197 feet in grasslands, and 2,657 feet in natural lands near urban areas. Along secondary roads with lower traffic volumes, the effect zone was 656 feet. The "road zone" effect with regard to California red-legged frogs has not been adequately investigated.

The necessity of moving between multiple habitats and breeding ponds means that many amphibian species, such as the California red-legged frog are especially vulnerable to roads and well-used large paved areas in the landscape. Van Gelder (1973) and Cooke (1995) have examined the effect of roads on amphibians and found that because of their activity patterns, population structure, and preferred habitats, aquatic breeding amphibians are more vulnerable to traffic mortality than some other species. The annual average daily traffic volume for Interstate 580 from Greenville Road to the Interstate 580/680 interchange ranged from 109,000 to 134,000 vehicles per day in 1997 and increased significantly from 142,000 to 196,000 in 2003. The average daily traffic volumes are projected to increase by 43% by 2025 (Caltrans 2008). Large, high-volume highways pose a nearly impenetrable barrier to amphibians and result in mortality to individual animals as well as significantly fragmenting habitat. Hels and Buchwald (2001) found that mortality rates for anurans on high traffic roads are higher than on low traffic roads. Vos and Chardon (1998) found a significant negative effect of road density on the occupation probability of ponds by the moor frog (*Rana arvalis*) in the Netherlands. In addition, incidences of very large numbers of road-killed frogs are well documented (e.g., Asley and Robinson 1996), and studies have shown strong population level effects of traffic density (Carr and Fahrig 2001) and high traffic roads on these amphibians (Van Gelder 1973; Vos and Chardon 1998). Most studies regularly count road kills from slow moving vehicles (Hansen 1982; Rosen and Lowe 1994; Drews 1995; Mallick et al. 1998) or by foot (Munguira and Thomas 1992). These studies assume that every victim is observed, which may be true for large conspicuous mammals, but it certainly is not true for small animals, such as the California red-legged frog. Amphibians appear especially vulnerable to traffic mortality because they readily attempt to cross roads, are slow-moving and small, and thus can not easily be avoided by drivers (Carr and Fahrig 2001).

Status of the Species: The recovery plan for red-legged frogs identifies eight Recovery Units (Service 2002). The establishment of these Recovery Units is based on the Recovery Team's determination that various regional areas of the species' range are essential to its survival and recovery. The status of the red-legged frog will be considered within the smaller scale of Recovery Units as opposed to the overall range. These Recovery Units are delineated by major watershed boundaries as defined by U.S. Geological Survey hydrologic units and the limits of the range of the California red-legged frog. The goal of the draft recovery plan is to protect the long-term viability of all extant populations within each Recovery Unit. Within each Recovery Unit, core areas have been delineated and represent contiguous areas of moderate to high red-legged frog densities that are relatively free of exotic species such as bullfrogs. The goal of designating core areas is to protect metapopulations that, combined with suitable dispersal habitat, will allow for the long term viability within existing populations. This management strategy will allow for the recolonization of habitat within and adjacent to core areas that are naturally subjected to periodic localized extinctions, thus assuring the long-term survival and recovery of red-legged frogs.

Environmental Baseline

The action area is located within the East San Francisco Bay Core Area (Alameda Creek Hydrologic Sub-Area) in the Diablo Range and Salinas Valley Recovery Unit (Service 2002, 2006). The action area is not located within the final designated critical habitat issued on April 13, 2006, or the revised proposed critical habitat issued on September 16, 2008 (Service 2006 and 2008). The recovery action guidelines provide recommendations for minimizing the effects of various land and water uses, non-native species/predators, and air and water contamination in addition to outlining recommendations for habitat preservation. These recommendations assist in the conservation and recovery of the species, protect high quality habitat within core areas and priority watersheds, increase opportunities for dispersal, population expansion and recolonization, and provide connectivity between core areas and occupied watersheds. The conservation needs for the East San Francisco Bay Core Area are: (1) protect existing populations; (2) control non-native predators; (3) study effects of grazing in riparian corridors, ponds and uplands, e.g. on East Bay Regional Park District lands; (4) reduce impacts associated with livestock grazing; (5) protect habitat connectivity; (6) minimize effects of recreation and off-road vehicle use, e.g. Corral Hollow watershed; (7) avoid and reduce impacts of urbanization; and (8) protect habitat buffers from nearby urbanization.

The project is located within the known range of the California red-legged frog and the grazed grasslands, streams and tributaries (i.e., Alamo Creek, Tassajara Creek, Cottonwood Creek, Collier Canyon Creek, Arroyo Las Positas, and Arroyo Seco) within the action area are part of a larger mosaic of essential habitat features sustaining a viable core population – breeding, sheltering, foraging and dispersal – within the northern Livermore and Dublin foothills. The protocol habitat assessment conducted by Dr. Mark Jennings and Natural Resource Management (Caltrans 2008), identified nine locations within the action area suitable for the California red-legged frog: Tassajara Creek, Cottonwood Creek, Arroyo Las Positas (at three locations), Cayetano Creek, Seasonal Wetland 1 east of North Livermore Avenue, Arroyo Seco Creek, and the unnamed stream at Northfront Trailhead (Caltrans 2008). Five of these locations provide suitable breeding and year-round habitat for all life history stages including the Arroyo Seco Creek undercrossing, Arroyo Las Positas west of North 1st Street, Cayetano Creek/Arroyo Las Positas confluence, Arroyo Las Positas undercrossing near Isabel Avenue and East Airway Blvd., and Tassajara Creek undercrossing. The two other locations, i.e. Cottonwood Creek undercrossing and Seasonal Wetland 1, provide suitable non-breeding aquatic habitat. The grazed grasslands north of I-580 and within the action area provide terrestrial foraging habitat and promote juvenile dispersal and adult migration between the aforementioned creeks and tributaries, and other nearby aquatic resources outside the action area.

Several other creeks were assessed by Caltrans, but were determined not to be suitable for California red-legged frogs including Collier, Dublin, and Alamo creeks. The portions of these creeks within the action area have been modified from their natural state and consist of concrete trapezoidal flood control channels that contain numerous predators such as bullfrogs, largemouth bass (*Micropterus salmoides*), green sunfish (*Lepomis cyanellus*), western mosquitofish and Louisiana red-swamp crayfish (*Procambarus clarkia*).

Undeveloped lands north and south of I-580 comprising non-native annual grasslands, ruderal and rural residential provide suitable upland and dispersal habitat, and provide connectivity between areas of occupied habitat. Caltrans (2008) identified twelve reported occurrences within one-mile of the project footprint; all but two of which are located north of I-580 (CDFG 2009). These sightings are located east of Tassajara Creek and extend northward to Mount Diablo and

Los Vaqueros Reservoir (CDFG 2009). Lands south of I-580 have been modified by urbanization and suitable areas are largely restricted to intact stream corridors and adjacent areas of undeveloped lands. Movement among land tracts north of I-580 is relatively unrestricted. California red-legged frogs within the action area are under increasing pressure from habitat conversion and urbanization, development (i.e. Dublin Ranch, Fallon Village, Fallon Sports Park, Staples Ranch, Shea Center Livermore, and Livermore Toyota), and infrastructure, utility and safety improvement projects (i.e. I-580 Eastbound HOV, I-580/Isabel Avenue Interchange, and I-580/Charro Avenue Interchange).

Arroyo Las Positas, Arroyo Seco, Cayetano, Cottonwood, and Tassajara creeks, and Seasonal Wetland 1 are important to the conservation and recovery of the species based on the following: 1) they are located within the known range of the species and within the East San Francisco Bay Core Area; 2) they provide suitable habitat for all life history stages of the species; 3) they provide connectivity with occupied watersheds to the north; 4) they provide opportunities for dispersal, population expansion and recolonization; and 5) they are known inhabitants of Arroyo Las Positas, Arroyo Seco, Cayetano and Tassajara creeks and adjacent uplands. For these reasons, the Service has determined there is a reasonable potential for all California red-legged frog life history stages to inhabit, breed, forage, seek refuge or disperse within and through the action area.

California Tiger Salamander

Listing Status: The final rule listing the Central Valley population of the California tiger salamander as a threatened species was published on August 4, 2004 (Service 2004). Critical habitat was designated on August 23, 2005 in 19 counties for the Central Valley population (Service 2005c).

Description: The California tiger salamander is a large, stocky, terrestrial salamander with a broad, rounded snout. Recorded adult measurements have been as much as 8.2 inches (20.8 centimeters) long (Petranka 1998; Stebbins 2003). Tiger salamanders exhibit sexual dimorphism (differences in body appearance based on gender) with males tending to be larger than females. Tiger salamander coloration generally consists of random white or yellowish markings against a black body. The markings on adults California tiger salamanders tend to be more concentrated on the lateral sides of the body, whereas other tiger salamander species tend to have brighter yellow spotting that is heaviest on the dorsal surface.

Distribution: The California tiger salamander is endemic to California and historically inhabited the low-elevation grassland and oak savanna plant communities of the Central Valley, adjacent foothills, and Inner Coast Ranges (Jennings and Hayes 1994; Storer 1925; Shaffer et al. 1993). The species has been recorded from near sea level to approximately 3,900 feet (1,189 meters) in the Coast Ranges and to approximately 1,600 feet (488 meters) 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. The historic distribution in the Central Valley and surrounding foothills included northern Yolo County southward to northwestern Kern County and northern Tulare County. Three distinct California tiger salamander populations are reçognized and correspond to Santa Maria area within Santa Barbara County, the Santa Rosa Plain in Sonoma County, and vernal pool/grassland habitats throughout the Central Valley.

Status and Natural History: The tiger salamander has an obligate biphasic life cycle (Shaffer et al. 2004). Although the larvae develop in the vernal pools and ponds in which they were born, tiger salamanders are otherwise terrestrial and spend most of their post-metamorphic lives in widely dispersed underground retreats (Shaffer et al. 2004; Trenham et al. 2001). Because they spend most of their lives underground, tiger salamanders are rarely encountered even in areas where salamanders are abundant. Subadult and adult tiger salamanders typically spend the dry summer and fall months in the burrows of small mammals, such as California ground squirrels and Botta's pocket gopher (*Thomomys bottae*) (Storer 1925; Loredo and Van Vuren 1996; Petranka 1998; Trenham 1998a). Although ground squirrels have been known to eat tiger salamanders, the relationship with their burrowing hosts is primarily commensal (an association that benefits one member while the other is not affected) (Loredo et al. 1996; Semonsen 1998).

Tiger salamanders may also use landscape features such as leaf litter or desiccation cracks in the soil for upland refugia. Burrows often harbor camel crickets and other invertebrates that provide likely prey for tiger salamanders. Underground refugia also provide protection from the sun and wind associated with the dry California climate that can cause excessive drying of amphibian skin. Although California tiger salamanders are members of a family of "burrowing" salamanders, they are not known to create their own burrows. This may be due to the hardness of soils in the California ecosystems in which they are found. Tiger salamanders depend on persistent small mammal activity to create, maintain, and sustain sufficient underground refugia for the species. Burrows are short lived without continued small mammal activity and typically collapse within approximately 18 months (Loredo et al. 1996).

Upland burrows inhabited by tiger salamanders have often been referred to as aestivation sites. However, "aestivation" implies a state of inactivity, while most evidence suggests that tiger salamanders remain active in their underground dwellings. A recent study has found that tiger salamanders move, feed, and remain active in their burrows (Van Hattem 2004). Because tiger salamanders arrive at breeding ponds in good condition and are heavier when entering the pond than when leaving, researchers have long inferred that tiger salamanders are feeding while underground. Recent direct observations have confirmed this (Trenham 2001; Van Hattem 2004). Thus, "upland habitat" is a more accurate description of the terrestrial areas used by tiger salamanders.

Tiger salamanders typically emerge from their underground refugia at night during the fall or winter rainy season (November-May) to migrate to their breeding ponds (Stebbins 1989, 2003; Shaffer et al. 1993; Trenham et al. 2000). The breeding period is closely associated with the rainfall patterns in any given year with less adults migrating and breeding in drought years (Loredo and Van Vuren 1996; Trenham et al. 2000). Male salamander are typically first to arrive and generally remain in the ponds longer than females. Results from a 7-year study in Monterey County suggested that males remained in the breeding ponds for an average of 44.7 days while females remained for an average of only 11.8 days (Trenham et al. 2000). Historically, breeding ponds were likely limited to vernal pools, but now include livestock stock ponds. Ideal breeding ponds are typically fishless, and seasonal or semi-permanent (Barry and Shaffer 1994; Petranka 1998).

While in the ponds, adult salamanders mate and then the females lay their eggs in the water (Twitty 1941; Shaffer et al. 1993; Petranka 1998). Egg laying typically reaches a peak in January (Loredo and Van Vuren 1996; Trenham et al. 2000). 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). Eggs are often attached to objects, such as rocks and boards in ponds with no or limited vegetation (Jennings and Hayes 1994). Clutch sizes from a Monterey County study had an averaged of 814 eggs (Trenham et al. 2000). Seasonal pools may not exhibit sufficient depth, persistence, or other necessary parameters for adult breeding during times of drought (Barry and Shaffer 1994). After breeding and egg laying is complete, adults leave the pool and return to their upland refugia (Loredo et al. 1996; Trenham 1998a). Adult salamanders often continue to emerge nightly for approximately the next two weeks to feed in their upland habitat (Shaffer et al. 1993).

Tiger salamander larvae typically hatch within 10 to 24 days after eggs are laid (Storer 1925). The peak emergence of these metamorphs is typically between mid-June and mid-July (Loredo and Van Vuren 1996; Trenham et al. 2000). The larvae are totally aquatic and range in length from approximately 0.45 to 0.56 inches (1.14 to 1.42 centimeters) (Petranka 1998). They have yellowish gray bodies, broad fat heads, large, feathery external gills, and broad dorsal fins that extend well up their back. The larvae feed on zooplankton, small crustaceans, and aquatic insects for about six weeks after hatching, after which they switch to larger prey (J. Anderson 1968). Larger larvae have been known to consume the tadpoles of Pacific treefrogs (*Hyla regilla*), western spadefoot toads (*Spea hammondii*), and California red-legged frogs (J. Anderson 1968; P. Anderson 1968). Tiger salamander larvae are among the top aquatic predators in seasonal pool ecosystems. When not feeding, they often rest on the bottom in shallow water but are also found throughout the water column in deeper water. Young salamanders are wary and typically escape into vegetation at the bottom of the pool when approached by potential predators (Storer 1925).

The tiger salamander larval stage is typically completed in 3 to 6 months with most metamorphs entering upland habitat during the summer (Petranka 1998). In order to be successful, the aquatic phase of this species' life history must correspond with the persistence of its seasonal aquatic habitat. Most seasonal ponds and pools dry up completely during the summer. 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).

Larval development and metamorphosis can vary and is often site-dependent. Larvae collected near Stockton in the Central Valley during April varied between 1.88 to 2.32 inches (4.78 to 5.89 centimeters) in length (Storer 1925). Feaver (1971) found that larvae metamorphosed and left breeding pools 60 to 94 days after eggs had been laid, with larvae developing faster in smaller, more rapidly drying pools. Longer ponding duration typically results in larger larvae and metamorphosed juveniles that are more likely to survive and reproduce (Pechmann et al. 1989; Semlitsch et al. 1988; Morey 1998; Trenham 1998b). Larvae will perish if a breeding pond dries before metamorphosis is complete (P. Anderson 1968; Feaver 1971). Pechmann et al. (1988) found a strong positive correlation between ponding duration and total number of metamorphosing juveniles in five salamander species. In Madera County, Feaver (1971) found that only 11 of 30 sampled pools supported larval California tiger salamanders, and 5 of these dried before metamorphosis could occur. Therefore, out of the original 30 pools, only 6 (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).

Following metamorphosis, juveniles leave their pools and enter upland habitat. This emigration can occur in both wet and dry conditions (Loredo and Van Vuren 1996; Loredo et al. 1996). Wet conditions are more favorable for upland travel but rare summer rain events seldom occur as metamorphosis is completed and ponds begin to dry. As a result, juveniles may be forced to leave their ponds on rainless nights. Under dry conditions, juveniles may be limited to seeking upland refugia in close proximity to their aquatic larval pool. These individuals often wait until the next winter's rains to move further into more suitable upland refugia. Although likely rare, larvae may over-summer in permanent ponds. Juveniles remain active in their upland habitat, emerging from underground refugia during rainfall events to disperse or forage (Trenham and Shaffer 2005). Depending on location and other development factors, metamorphs will not return as adults to aquatic breeding habitat for 2 to 5 years (Loredo and Van Vuren 1996; Trenham et al. 2000).

Lifetime reproductive success for tiger salamander species is low. Results from one study suggest that the average female tiger salamander bred 1.4 times and produced 8.5 young per reproductive effort that survived to metamorphosis (Trenham et al. 2000). This resulted in the output of roughly 11 metamorphic offspring over a breeding female's lifetime. The primary reason for low reproductive success may be that this relatively short-lived species requires two or more years to become sexually mature (Shaffer et al. 1993). Some individuals may not breed until they are four to six years old. While California tiger salamanders may survive for more than ten years, many breed only once, and in one study, less than 5 percent of marked juveniles survived to become breeding adults (Trenham 1998b). With such low recruitment, isolated populations are susceptible to unusual, randomly occurring natural events as well human-caused factors that reduce breeding success and individual survival. Factors that repeatedly lower breeding success in isolated pools can quickly extirpate a population.

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

Tiger salamanders are known to travel large distances between breeding ponds and their upland refugia. Generally it is difficult to establish the maximum distances traveled by any species, but tiger salamanders in Santa Barbara County have been recorded dispersing up to 1.3 miles (2.1 kilometers) from their breeding ponds (Sweet 1998). Tiger salamanders are also 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 other ponds approximately 1,900 and 2,200 feet (579 to 671 meters) away (Trenham et al. 2001). In addition to traveling long distances during juvenile dispersal and adult migration, tiger salamanders may reside in burrows far from their associated breeding ponds.

Although previously cited information indicates that tiger salamanders can travel long distances, they typically remain close to their associated breeding ponds. A trapping study conducted in Solano County during the winter of 2002/2003 suggested that juveniles dispersed and used upland habitats further from breeding ponds than adults (Trenham and Shaffer 2005). More juvenile salamanders were captured at traps placed at 328, 656, and 1,312 feet (100, 200, and 400 meters) from a breeding pond than at 164 feet (50 meters). Approximately 20 percent of the captured juveniles were found at least 1,312 feet (400 meters) from the nearest breeding pond.

The associated distribution curve suggested that 95 percent of juvenile salamanders were within 2,099 feet (640 meters) of the pond, with the remaining 5 percent being found at even greater distances. Preliminary results from the 2003-04 trapping efforts at the same study site detected juvenile tiger salamanders at even further distances, with a large proportion of the captures at 2,297 feet (700 meters) from the breeding pond (Trenham et al., unpublished data). Surprisingly, most juveniles captured, even those at 2,100 feet (640 meters), were still moving away from ponds (Ben Fitzpatrick, University of California at Davis, personal communication, 2004). In Santa Barbara County, juvenile California tiger salamanders have been trapped approximately 1,200 feet (366 meters) away while dispersing from their natal pond (Science Applications International Corporation, unpublished data). These data show that many California tiger salamanders travel far while still in the juvenile stage. Post-breeding movements away from breeding ponds by adults appear to be much smaller. During post-breeding emigration from aquatic habitat, radio-equipped adult tiger salamanders were tracked to burrows between 62 to 813 feet (19 to 248 meters) from their breeding ponds (Trenham 2001). These reduced movements may be due to adult California tiger salamanders exiting the ponds with depleted physical reserves, or drier weather conditions typically associated with the post-breeding upland migration period.

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 were more abundant in grasslands with scattered large oaks (*Quercus* spp.), than in more densely wooded areas. Based on radio-tracked adults, there is no indication that certain habitat types are favored as terrestrial movement corridors (Trenham 2001). In addition, captures of arriving adults and dispersing new metamorphs were evenly distributed around two ponds completely encircled by drift fences and pitfall traps. Thus, it appears that dispersal into the terrestrial habitat occurs randomly with respect to direction and habitat types.

Threats: Documented or potential tiger salamanders predators include coyotes (*Canis latrans*), raccoons (*Procyon lotor*), striped skunks (*Mephitis mephitis*), opossums (*Didelphis virginiana*), egrets (*Egretta species*), great blue herons (*Ardea herodias*), crows (*Corvus brachyrhynchos*), ravens (*Corvus corax*), garter snakes (*Thamnophis species*), bullfrogs, California red-legged frogs, mosquito fish, and crayfish (*Procrambus* spp.). Domestic dogs have been observed eating California tiger salamanders at Lake Lagunitas at Stanford University (Sean Barry, ENTRIX, personal communication to C. Nagano, July 2004).

The California tiger salamander is imperiled throughout its range due to a variety of human activities (Service 2004). Current factors associated with declining tiger salamander populations include continued habitat loss and degradation due to agriculture and urbanization; hybridization with the non-native eastern tiger salamander (*Ambystoma tigrinum*) (Fitzpatrick and Shaffer 2004; Riley et al. 2003); and predation by introduced species. California tiger salamander populations are likely threatened by multiple factors but continued habitat fragmentation and colonization of non-native salamanders may represent the most significant current threats. Habitat isolation and fragmentation within many watersheds have precluded dispersal between 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 include disease, predation, interspecific competition, urbanization and population growth, exposure to contaminants, rodent and mosquito control, road-crossing mortality, and hybridization with non-native salamanders.

Currently, these various primary and secondary threats are largely not being offset by existing federal, state, or local regulatory mechanisms. The tiger salamander is also prone to chance environmental or demographic events, to which small populations are particularly vulnerable.

The necessity of moving between multiple habitats and breeding ponds means that many amphibian species, such as the California tiger salamander are especially vulnerable to roads and well-used large paved areas in the landscape. Van Gelder (1973) and Cooke (1995) have examined the effect of roads on amphibians and found that because of their activity patterns, population structure, and preferred habitats, aquatic breeding amphibians are more vulnerable to traffic mortality than some other species. The annual average daily traffic volume for Interstate 580 from Greenville Road to the Interstate 580/680 interchange ranged from 109,000 to 134,000 vehicles per day in 1997 and increased significantly from 142,000 to 196,000 in 2003 (Caltrans 2003). The average daily traffic volumes are projected to increase by 43% by 2025 (Caltrans 2008). Large, high-volume highways pose a nearly impenetrable barrier to amphibians and result in mortality to individual animals as well as significantly fragmenting habitat. Hels and Buchwald (2001) found that mortality rates for anurans on high traffic roads are higher than on low traffic roads (Hels and Buchwald 2001). Vos and Chardon (1998) found a significant negative effect of road density on the occupation probability of ponds by the moor frog (Rana arvalis) in the Netherlands. In addition, incidences of very large numbers of road-killed frogs are well documented (e.g., Asley and Robinson 1996), and studies have shown strong population level effects of traffic density (Carr and Fahrig 2001) and high traffic roads on these amphibians (Van Gelder 1973; Vos and Chardon 1998). Most studies regularly count road kills from slow moving vehicles (Hansen 1982; Rosen and Lowe 1994; Drews 1995; Mallick et al. 1998) or by foot (Munguira and Thomas 1992). These studies assume that every victim is observed, which may be true for large conspicuous mammals, but it certainly is not true for small animals, such as the California red-legged frog. Amphibians appear especially vulnerable to traffic mortality because they readily attempt to cross roads, are slow-moving and small, and thus can not easily be avoided by drivers (Carr and Fahrig 2001).

The direction and type of habitat used by dispersing animals is especially important in fragmented environments (Forys and Humphrey 1996). Models of habitat patch geometry predict that individual animals will exit patches at more "permeable" areas (Buechner 1987; Stamps et al. 1987). A landscape corridor may increase the patch-edge permeability by extending patch habitat (La Polla and Barrett 1993), and allow individuals to move from one patch to another. The geometric and habitat features that constitute a "corridor" must be determined from the perspective of the animal (Forys and Humphrey 1996).

Because their habitats have been fragmented, many endangered and threatened species exist as metapopulations (Verboom and Apeldom 1990; Verboom et al. 1991). A metapopulation is a collection of spatially discrete subpopulations that are connected by the dispersal movements of the individuals (Levins 1970; Hanski 1991). For metapopulations of listed species, a prerequisite to recovery is determining if unoccupied habitat patches are vacant due to the attributes of the habitat patch (food, cover, and patch area) or due to patch context (distance of the patch to other patches and distance of the patch to other features). Subpopulations on patches with higher quality food and cover are more likely to persist because they can support more individuals. Large populations have less of a chance of extinction due to stochastic events (Gilpin and Soule 1986). Similarly, small patches will support fewer individuals, increasing the rate of extinction. Patches that are near occupied patches are more likely to be recolonized when local extinction occurs and may benefit from emigration of individuals via the "rescue" effect (Hanski 1982; Gotelli 1991; Holt 1993; Fahrig and Merriam 1985). For the metapopulation to persist, the rate of patches being colonized must exceed the rate of patches going extinct (Levins 1970). If some subpopulations go extinct regardless of patch context, recovery actions should be placed on patch attributes. Patches could be managed to increase the availability of food and/or cover. Movements and dispersal corridors likely are critical to California tiger salamander population dynamics, particularly because the animals likely currently persist as metapopulations with disjunct population centers. Movement and dispersal corridors are important for alleviating over-crowding and intraspecific competition, and also they are important for facilitating the recolonization of areas where the animal has been extirpated. Movement between population centers maintains gene flow and reduced genetic isolation. Genetically isolated populations are at greater risk of deleterious genetic effects such as inbreeding, genetic drift, and founder effects. The survival of wildlife species in fragmented habitats may ultimately depend on their ability to move among patches to access necessary resources, retain genetic diversity, and maintain reproductive capacity within populations (Hilty and Merenlender 2004; Petit et al. 1995; Buza et al. 2000).

Most metapopulation or meta-population-like models of patchy populations do not directly include the effects of dispersal mortality on population dynamics (Hanski 1994; With and Crist 1995; Lindenmayer and Possingham 1996). Based on these models, it has become a widely held notion that more vagile species have a higher tolerance to habitat loss and fragmentation than less vagile species. But models that include dispersal mortality predict exactly the opposite: more vagile species should be more vulnerable to habitat loss and fragmentation becase they are more susceptible to dispersal mortality (Fahrig 1998; Casagrandi and Gatto 1999). This prediction is supported by Gibbs (1998), who examined the presence-absence of five amphibian species across a gradient of habitat loss. He found that species with low dispersal rates are better able than more vagile species to persist in landscapes with low habitat cover. Gibbs (1998) postulated that the land between habitats serves as a demographic "drain" for many amphibians. Furthermore, Bonnet et al. (1999) found that snake species that use frequent long-distance movements have higher mortality rates than do sedentary species.

Negative effects to wildlife populations from roads and pavement may extend some distance from the actual road, as the proposed project. The phenomenon can result from any of the effects already described in this biological opinion, such as vehicle-related mortality, habitat degradation, and invasive exotic species. Forman and Deblinger (1998) described the area affected as the "road effect" zone. Along a 4-lane road in Massachusetts, they determined that this zone extend for an average of approximately 980 feet to either side of the road for an average total zone width of approximately 1970 feet. However, in places they detected an effect > 0.6 mile from the road. Rudolph *et al.* (1999) detected reduced snake abundance up to 2,790 feet from roads in Texas. They estimated snake abundance out to 2,790 feet, so the effect may have been greater. Extrapolating to a landscape scale, they concluded the effect of roads on snake populations in Texas likely was significant, given that approximately 79% of the land area of the Lone Star State is within 1,640 feet of a road. The "road-zone" effects can be subtle. Van der Zandt *et al.* (1980) reported that lapwings (*Vanellus vanellus*) and black-tailed godwits (*Limosa limosa*) feeding at 1,575 feet-6,560 feet from roads were disturbed by passing vehicles. The heart rate, metabolic rate and energy expenditure of female bighorn sheep (*Ovis canadensis*) increases near roads (MacArthur et al. 1979). Trombulak and Frossell (2000) described another type of "road-zone' effect. Heavy metal concentrations from vehicle exhaust were greatest within 66 feet of roads, by elevated levels of metals in both soil and plants were detected at 660 feet of roads. The "road-zone" apparently varies with habitat type and traffic volume. Based on responses by birds, Forman (2000) estimated the effect zone along primary roads of 1,000 feet in woodlands, 1,197 feet in grasslands, and 2,657 feet in natural lands near urban areas. Along secondary roads with lower traffic volumes, the effect zone was 656 feet. The "road zone" and the California tiger salamander have not been adequately investigated.

Status of the Species: Thirty-one percent (221 of 711 records and occurrences) of all Central Valley DPS California tiger salamander records and occurrences are located 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 (Buckingham in litt. 2003; CDFG 2009; Service 2004). The California Department of Fish and Game (2009) now considers 13 of these records from the Bay Area region as extirpated or likely to be extirpated.

Of the 140 reported California tiger salamander localities where wetland habitat was identified, only 7 percent were located in vernal pools (CDFG 2009). The Bay Area is located 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). 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). During the 1980s and 1990s, vernal pools were lost at a 1.1 percent annual rate in Alameda County (Holland 1998).

Due to the extensive losses of vernal pool complexes and their limited distribution in the Bay Area region, many California tiger salamander breeding sites consist of artificial water bodies. Overall, 89 percent (124) of the identified water bodies are stock, farm, or berm ponds used by cattle grazing and/or as a temporary water source for small farm irrigation (CDFG 2009). This places the California tiger salamander at great risk of hybridization with non-native tiger salamanders, especially in Santa Clara and San Benito counties. 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 (Shaffer in litt. 2003).

Shaffer et al. (1993) found that the East Bay counties of Alameda and Contra Costa supported the greatest concentrations of California tiger salamander. California tiger salamander populations in the Livermore Valley are severely threatened by the ongoing conversion of grazing land to subdivisions and vineyards (Stebbins 1989; East Bay Regional Park District 2003). Proposed land conversion continues to target large areas of California tiger salamander habitat. One such project in Alameda County totals 700 acres (283 hectares) (East Bay Regional Parks District 2003). Other proposed projects located within the California tiger salamander's distribution include another 310-acre (125-hectare) project in Alameda County, two in San Joaquin County totaling 12,427 acres (5,029 hectares), and a 19-acre (7.7-hectare) project in Santa Clara County. California tiger salamanders are under increasing pressure from habitat conversion and urbanization, development (i.e. Dublin Ranch, Fallon Village, Fallon Sports Park, Staples Ranch, Shea Center Livermore, and Livermore Toyota), and infrastructure, utility and safety improvement projects (i.e. I-580 Eastbound HOV, I-580/Isabel Avenue Interchange, and I-580/Charro Avenue Interchange). The species' low recruitment and high juvenile mortality makes it particularly susceptible to habitat loss, fragmentation, urbanization, and construction related harm and mortality. Most of the California tiger salamander natural historic habitat (vernal pool grasslands) available in this region has been lost due to urbanization and conversion to intensive agriculture (Keeler-Wolf et al. 1998). California tiger salamanders are now primarily restricted to artificial breeding ponds, such as bermed ponds or stock ponds, which are typically located at higher elevations (CDFG 2009).

Environmental Baseline

Dr. Mark Jennings and Natural Resource Management staff performed a field investigation in September 2007 and prepared a habitat assessment in support of the Biological Assessment (Caltrans 2008). According to the Biological Assessment, there are 37 reported California tiger salamander occurrences within 3.1 miles of the action area; eleven of which are located within 1.24 miles (Caltrans 2008, CDFG 2009). The majority of these occurrences are located north of I-580 east of Tassajara Creek. Suitable breeding habitat was identified at a single location within the action area, Seasonal Wetland 1 (Caltrans 2008). Undeveloped lands north and south of I-580 comprising non-native annual grasslands, ruderal and rural residential provide suitable upland (i.e., aestivation, foraging and refugia) and dispersal habitat, and provide connectivity between areas of occupied habitat. Lands south of I-580 have been modified by urbanization and suitable areas are largely restricted to actively grazed grasslands. Movement among land tracts north of I-580 is relatively unrestricted. California tiger salamander within the action area are under increasing pressure from habitat conversion and urbanization, development (i.e. Dublin Ranch, Fallon Village, Fallon Sports Park, Staples Ranch, Shea Center Livermore, and Livermore Toyota), and infrastructure, utility and safety improvement projects (i.e. I-580 Eastbound HOV, I-580/Isabel Avenue Interchange, and I-580/Charro Avenue Interchange).

These habitat features are important to the conservation and recovery of the species based on the following: (1) they are located within the known range of the species; (2) they provide suitable habitat for all life history stages of the species; (3) they provide connectivity with occupied watersheds to the north; and (4) they provide opportunities for dispersal, population expansion and recolonization. For these reasons, the Service has determined there is a reasonable potential for California tiger salamanders to inhabit, breed, forage, aestivate and disperse through the action area.

San Joaquin Kit Fox

Listing Status: The San Joaquin kit fox was listed as an endangered species on March 11, 1967 (Service 1967) and was listed by the State of California as a threatened species on June 27, 1971. Critical Habitat has not been designated for this species. The Recovery Plan for Upland Species of the San Joaquin Valley, California includes this species (Service 1998).

Status and Natural History: In the San Joaquin Valley before 1930, the range of the San Joaquin kit fox extended from southern Kern County north to Tracy in San Joaquin County, on the west side, and near La Grange in Stanislaus County, on the east side (Grinnell et al. 1937; Service 1998). Historically, this species occurred in several San Joaquin Valley native plant communities. In the southernmost portion of the range, these communities included Valley Sink Scrub, Valley Saltbush Scrub, Upper Sonoran Subshrub Scrub, and Annual Grassland. San Joaquin kit foxes also exhibit a capacity to utilize habitats that have been altered by man. This fox species is present in many oil fields, grazed pasturelands, and "wind farms" (Cypher 2000). Kit foxes can inhabit the margins and fallow lands near irrigated row crops, orchards, and vineyards, and may forage occasionally in these agricultural areas (Service 1998). There are a limited number of observations of San Joaquin kit foxes foraging in trees in urban areas (Murdoch et al. 2005). The San Joaquin kit fox seems to prefer more gentle terrain and decreases in abundance as terrain ruggedness increases (Grinnell et al. 1937; Morrell 1972; Warrick and Cypher 1999).

Adult San Joaquin kit foxes are usually solitary during late summer and fall. In September and October, adult females begin to excavate and enlarge natal dens (Morrell 1972), and adult males join the females in October or November (Morrell 1972). Typically, pups are born between February and late March following a gestation period of 49 to 55 days (Egoscue 1962; Morrell 1972; Spiegel and Tom 1996; Service 1998). Mean litter sizes reported for San Joaquin kit foxes include 2.0 pups on the Carrizo Plain (White and Ralls 1993), 3.0 at Camp Roberts (Spencer et al. 1992), 3.7 in the Lokern area (Spiegel and Tom 1996), and 3.8 at the Naval Petroleum Reserve (Cypher et al. 2000). Pups appear above ground at the age of about 3-4 weeks, and are weaned at the age of 6-8 weeks. Adult San Joaquin kit fox reproductive rates (the proportion of females bearing young) vary annually with environmental conditions, particularly food availability. Annual rates range from 0-100 percent, and reported mean rates include 61 percent at the Naval Petroleum Reserve (Cypher et al. 2000), 64 percent in the Lokern area (Spiegel and Tom 1996), and 32 percent at Camp Roberts (Spencer et al. 1992). Although some yearling female kit foxes will produce young, most do not reproduce until they have reached 2 years-of-age (Spencer et al. 1992; Spiegel and Tom 1996; Cypher et al. 2000). Some young of both sexes, but particularly females, may delay dispersal and may assist their parents in raising the following year's litter of pups (Spiegel and Tom 1996). The young kit foxes begin to forage for themselves at about 4-5 months of age (Koopman et al. 2000; Morell 1972).

Although most young kit foxes disperse less than 5 miles (8 kilometers) from their natal home ranges (Scrivner et al. 1987), dispersal distances of up to 76.3 miles (122.8 kilometers) have been documented for the San Joaquin kit fox (Scrivner et al. 1987; Service 1998). Dispersal can be through disturbed habitats, including agricultural fields, and across highways and aqueducts. The age at dispersal ranges from 4-32 months (Cypher 2000). Among juvenile kit foxes surviving to July 1 at the Naval Petroleum Reserve, 49 percent of the males dispersed while 24 percent of the females dispersed from natal home ranges (Koopman et al. 2000). Among dispersing kit foxes, 87 percent did so during their first year of age. Most, 65.2 percent, of the dispersing juveniles at the Naval Petroleum Reserve died within 10 days of leaving their natal home den (Koopman et al. 2000). Some kit foxes delay dispersal and may inherit their natal home range.

San Joaquin kit foxes are reputed to be poor diggers, and their dens are usually located in areas with loose-textured, friable soils (Morrell 1972; O'Farrell 1983). However, the depth and complexity of their dens suggest that they possess good digging abilities, and kit fox dens have been observed on a variety of soil types (Service 1998). Some studies have suggested that where hardpan layers predominate, kit foxes create their dens by enlarging the burrows of California ground squirrels (*Spermophilus beecheyi*) or American badgers (*Taxidea taxus*) (Jensen 1972; Morrell 1972; Orloff et al. 1986). In parts of their range, particularly in the foothills, kit foxes often use ground squirrel burrows for dens (Orloff et al. 1986). Kit fox dens are commonly located on flat terrain or on the lower slopes of hills. About 77 percent of all kit fox dens are at or below mid-slope (O'Farrell 1983), with the average slope at den sites ranging from 0 to 22 degrees (CDFG 1980; O'Farrell 1983; Orloff et al. 1986). Natal and pupping dens are generally found in flatter terrain. Common locations for dens include washes, drainages, and roadside berms. Kit foxes also commonly den in human-made structures such as culverts and pipes (O'Farrell 1983; Spiegel et al. 1996).

Natal and pupping dens of the San Joaquin kit fox may include from 2 to 18 entrances and are usually larger than dens that are not used for reproduction (O'Farrell et al. 1980; O'Farrell and

McCue 1981). Natal dens may be reused in subsequent years (Egoscue 1962). It has been speculated that natal dens are located in the same location as ancestral breeding sites (O'Farrell 1983). Active natal dens are generally 1.2 to 2 miles (1.9 to 3.2 kilometers) from the dens of other mated kit fox pairs (Egoscue 1962; O'Farrell and Gilbertson 1979). Natal and pupping dens usually can be identified by the presence of scat, prey remains, matted vegetation, and mounds of excavated soil (i.e. ramps) outside the dens (O'Farrell 1983). However, some active dens in areas outside the valley floor often do not show evidence of use (Orloff et al. 1986). During telemetry studies of kit foxes in the northern portion of their range, 70 percent of the dens that were known to be active showed no sign of use (e.g., tracks, scats, ramps, or prey remains) (Orloff et al. 1986). In another more recent study in the Coast Range, 79 percent of active kit fox dens lacked evidence of recent use other than signs of recent excavation (Jones and Stokes Associates 1997).

A San Joaquin kit fox can use more than 100 dens throughout its home range, although on average, an animal will use approximately 12 dens a year for shelter and escape cover (Cypher et al. 2001). Kit foxes typically use individual dens for only brief periods, often for only one day before moving to another den (Ralls et al. 1990). Possible reasons for changing dens include infestation by ectoparasites (parasites that live on but not within their hosts), local depletion of prey, or avoidance of coyotes (*Canis latrans*). Kit foxes tend to use dens that are located in the same general area, and clusters of dens can be surrounded by hundreds of hectares of similar habitat devoid of other dens (Egoscue 1962). In the southern San Joaquin Valley, kit foxes were found to use up to 39 dens within a denning range of 320 to 482 acres (129.5 to 195 hectares) (Morrell 1972). An average den density of one den per 69 to 92 acres (27.9 to 37.2 hectares) was reported by O'Farrell (1983) in the southern San Joaquin Valley.

Dens are used by San Joaquin kit foxes for temperature regulation, shelter from adverse environmental conditions, and escape from predators. Kit foxes excavate their own dens, use those constructed by other animals, and use human-made structures (culverts, abandoned pipelines, and banks in sumps or roadbeds). Kit foxes often change dens and may use many dens throughout the year; however, evidence that a den is being used by kit foxes may be absent. San Joaquin kit foxes have multiple dens within their home range and individual animals have been reported to use up to 70 different dens (Hall 1983). At the Naval Petroleum Reserve, individual kit foxes used an average of 11.8 dens per year (Koopman et al. 1998). Den switching by the San Joaquin kit fox may be a function of predator avoidance, local food availability, or external parasite infestations (e.g., fleas) in dens (Egoscue 1956).

The diet of the San Joaquin kit fox varies geographically, seasonally, and annually, based on temporal and spatial variation in abundance of potential prey. Known prey species of the kit fox include white-footed mice (*Peromyscus* spp.), insects, California ground squirrels, kangaroo rats (*Dipodomys* spp.), San Joaquin antelope squirrels (*Ammospermophilus nelsoni*), black-tailed hares (*Lepus californicus*), and chukar (*Alectoris chukar*) (Jensen 1972; Archon 1992). Kit foxes also prey on desert cottontails (*Sylvilagus audubonii*), ground-nesting birds, and pocket mice (*Perognathus* spp.).

The diets and habitats selected by coyotes and San Joaquin kit foxes living in the same areas are often quite similar. Hence, the potential for resource competition between these species may be quite high when prey resources are scarce such as during droughts, which are quite common in semi-arid, Central California. Competition for resources between coyotes and kit foxes may result in kit fox mortalities. Coyote-related injuries accounted for 50-87 percent of the mortalities of radio collared kit foxes at Camp Roberts, the Carrizo Plain Natural Area, the

Lokern Natural Area, and the Naval Petroleum Reserve (Cypher and Scrivner 1992; Standley et al. 1992).

San Joaquin kit foxes are primarily nocturnal, although individuals are occasionally observed resting or playing (mostly pups) near their dens during the day (Grinnell et al. 1937). Kit foxes occupy home ranges that vary in size from 1.7 to 4.5 square miles (2.7 to 7.2 square kilometers) (White and Ralls 1993). A mated pair of kit foxes and their current litter of pups usually occupy each home range (White and Ralls 1993, Spiegel 1996; White and Garrott 1997). Other adults, usually offspring from previous litters, also may be present (Koopman et al. 2000), but individuals often move independently within their home range (Cypher 2000). Ralls et al. (2001) found that foxes sometimes share dens with foxes from other groups; many of these cases involved unpaired individuals and appeared to be unsuccessful attempts at pair formation. Average distances traveled each night range from 5.8 to 9.1 miles (9.3 to 14.6 kilometers) and are greatest during the breeding season (Cypher 2000).

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

Estimates of fox density vary greatly throughout its range, and have been reported as high as 3.11 per square mile (1.94 per square kilometer) in optimal habitats in good years (Service 1998). At the Elk Hills in Kern County, density estimates varied from 1.86 animals per square mile (1.16 per square kilometer) in the early 1980s to 0.03 animals per square mile (0.02 per square kilometer) in 1991 (Service 1998). Kit fox home ranges vary in size from approximately 1 to 12 square miles (1.6 to 19.3 square kilometers) (Spiegel et al. 1996; Service 1998). Knapp (1978) estimated that a home range in agricultural areas is approximately 1.0 square mile (1.6 square kilometers). Individual home ranges overlap considerably, at least outside the core activity areas (Morrell 1972; Spiegel et al. 1996).

Mean annual survival rates reported for adult San Joaquin kit foxes include 0.44 at the Naval Petroleum Reserve (Cypher et al. 2000), 0.53 at Camp Roberts (Standley et al. 1992), 0.56 at the Lokern area (Spiegel and Disney 1996), and 0.60 on the Carrizo Plain (Ralls and White 1995). However, survival rates widely vary among years (Spiegel and Disney 1996; Cypher et al. 2000). Mean survival rates for juvenile San Joaquin kit foxes (<1 year old) are lower than rates for adults. Survival to 1 year-of-age was 0.14 at the Naval Petroleum Reserve (Cypher et al. 2000), 0.20 at Camp Roberts (Standley et al. 1992), and 0.21 on the Carrizo Plain (Ralls and White 1995). For both adults and juveniles, survival rates of males and females are similar. San Joaquin kit foxes may live 10 years in captivity (McGrew 1979) and 8 years in the wild (Berry et al. 1987), but most kit foxes do not live past 2-3 years of age.

The status (i.e., distribution, abundance) of the kit fox has decreased since its listing in 1967. This trend is reasonably certain to continue into the foreseeable future unless measures to protect, sustain, and restore suitable habitats, and alleviate other threats to their survival and recovery, are implemented. Threats that are seriously affecting kit foxes are described in further detail in the following sections.

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

This rate of loss accelerated following the completion of the Central Valley Project and the State Water Project, which diverted and imported new water supplies for irrigated agriculture (Service 1995). Approximately 1.97 million acres (0.79 million hectares) of habitat, or about 66,000 acres (26,709 hectares) per year, were converted in the San Joaquin region between 1950 and 1980 (Cowardin et al. 1988). The counties specifically noted as having the highest wild land conversion rates included Kern, Tulare, Kings and Fresno, all of which are occupied by the kit fox. From 1959 to 1969 alone, an estimated 34 percent of natural lands were lost within the then-known kit fox range (Laughrin 1970).

By 1979, only approximately 370,000 acres (149,734 hectares) out of a total of approximately 8.5 million acres (3.4 million hectares) on the San Joaquin Valley floor remained as non-developed land (Williams 1985; Service 1980). Data from the California Department of Fish and Game (1985) and Service file information indicate that between 1977 and 1988, essential habitat for the blunt-nosed leopard lizard (*Gambelia silus*), a species that occupies habitat that is also suitable for kit foxes, declined by about 80 percent – from 311,680 acres (126,133 hectares) to 63,060 acres (25,520 hectares), an average of about 22,000 acres (8,903 hectares) per year (Biological Opinion for the Interim Water Contract Renewal, Service file 1-1-00-F-0056, February 29, 2000). Virtually all of the documented loss of essential habitat was the result of conversion to irrigated agriculture.

During 1990 to 1996, a gross total of approximately 71,500 acres (28,935 hectares) of habitat were converted to farmland in 30 counties (total area 23.1 million acres [9.3 million hectares]) within the Conservation Program Focus area of the Central Valley Project. This figure includes 42,520 acres (17,207 hectares) of grazing land and 28,854 acres (11,677 hectares) of "other" land, which is predominantly comprised of native habitat. During this same time period, approximately 101,700 acres (41,157 hectares) were converted to urban land use within the Conservation Program Focus area (California Department of Conservation 1994, 1996, 1998). This figure includes 49,705 acres (20,115 hectares) of farmland, 20,476 acres (8286 hectares) of grazing land, and 31,366 acres (12,693 hectares) of "other" land, which is predominantly comprised of native habitat. Because these assessments included a substantial portion of the Central Valley and adjacent foothills, they provide the best scientific and commercial information currently available regarding the patterns and trends of land conversion within the kit fox's geographic range. More than 1 million acres (0.4 million hectares) of suitable habitat for kit foxes have been converted to agricultural, municipal, or industrial uses since the listing of the kit fox. In contrast, less than 500,000 acres (202,343 hectares) have been preserved or are subject to community-level conservation efforts designed, at least in part, to further the conservation of the kit fox (Service 1998).

Land conversions contribute to declines in kit fox abundance through direct and indirect mortalities, displacement, reduction of prey populations and denning sites, changes in the distribution and abundance of larger canids that compete with kit foxes for resources, and reductions in carrying capacity. Kit foxes may be buried in their dens during land conversion activities (C. Van Horn, Endangered Species Recovery Program, Bakersfield, personal communication to S. Jones, U.S. Fish and Wildlife Service, Sacramento, California, 2000), or permanently displaced from areas where structures are erected or the land is intensively irrigated (Jensen 1972; Morrell 1975). Furthermore, even moderate fragmentation or loss of habitat may significantly impact the abundance and distribution of kit foxes. Capture rates of kit foxes at the Naval Petroleum Reserve in Elk Hills were negatively associated with the extent of oil-field development after 1987 (Warrick and Cypher 1999). Likewise, the California Energy Commission found that the relative abundance of kit foxes was lower in oil-developed habitat than in nearby undeveloped habitat on the Lokern (Spiegel 1996). Researchers from both studies inferred that the most significant effect of oil development was the lowered carrying capacity for populations of both foxes and their prey species owing to the changes in habitat characteristics or the loss and fragmentation of habitat (Spiegel 1996; Warrick and Cypher 1999).

Dens are essential for the survival and reproduction of kit foxes that use them year-round for shelter and escape and in the spring for rearing young. Hence, kit foxes generally have dozens of dens scattered throughout their territories. However, land conversion reduces the number of typical earthen dens available to kit foxes. For example, the average density of typical, earthen kit fox dens at the Naval Hills Petroleum Reserve was negatively correlated with the intensity of petroleum development (Zoellick et al. 1987), and almost 20 percent of the dens in developed areas were found to be in well casings, culverts, abandoned pipelines, oil well cellars, or in the banks of sumps or roads (Service 1983). These results are important because the California Energy Commission found that, even though kit foxes frequently used pipes and culverts as dens in oil-developed areas of western Kern County, only earthen dens were used to birth and wean pups (Spiegel 1996). Similarly, kit foxes in Bakersfield use atypical dens, but have only been found to rear pups in earthen dens (Patrick Kelly, Endangered Species Recovery Program, Fresno, California, personal communication to P. White, U.S. Fish and Wildlife Service, Sacramento, California, April 6, 2000). Hence, the fragmentation of habitat and destruction of earthen dens could adversely affect the reproductive success of kit foxes. Furthermore, the destruction of earthen dens may also affect kit fox survival by reducing the number and distribution of escape refuges from predators.

Land conversions and associated human activities can lead to widespread changes in the availability and composition of mammalian prey for kit foxes. For example, oil field disturbances in western Kern County have resulted in shifts in the small mammal community from the primarily granivorous species that are the staple prey of kit foxes (Spiegel 1996), to species adapted to early successional stages and disturbed areas (e.g., California ground squirrels) (Spiegel 1996). Because more than 70 percent of the diets of kit foxes usually consist of abundant rabbits (*Lepus* and *Sylvilagus* spp.) and rodents (e.g., *Dipodomys* spp.), and kit foxes often continue to feed on their staple prey during ephemeral periods of prey scarcity, such changes in the availability and selection of foraging sites by kit foxes could influence their reproductive rates, which are strongly influenced by food supply and decrease during periods of prey scarcity (White and Garrott 1997, 1999).

Extensive habitat destruction and fragmentation have contributed to smaller, more-isolated populations of kit foxes. Small populations have a higher probability of extinction than larger populations because their low abundance renders them susceptible to stochastic (i.e., random) events such as high variability in age and sex ratios, and catastrophes such as floods, droughts, or disease epidemics (Lande 1988; Frankham and Ralls 1998; Saccheri et al. 1998). Similarly, isolated populations are more susceptible to extirpation (localized extinction) by accidental or natural catastrophes because their recolonization has been hampered. These chance events can adversely affect small, isolated populations with devastating results. Extirpation can even occur when the members of a small population are healthy, because whether the population increases or decreases in size is less dependent on the age-specific probabilities of survival and reproduction than on raw chance (sampling probabilities). Owing to the probabilistic nature of extinction, many small populations will eventually lose out and go extinct when faced with these stochastic risks (Caughley and Gunn 1995).

Oil fields in the southern half of the San Joaquin Valley also continue to be an area of expansion and development activity. This expansion is reasonably certain to increase in the near future owing to market-driven increases in the price of oil. The cumulative and long-term effects of oil extraction activities on kit fox populations are not fully known, but recent studies indicate that moderate- to high-density oil fields may contribute to a decrease in carrying capacity for kit foxes owing to habitat loss or changes in habitat characteristics (Spiegel 1996; Warrick and Cypher 1999). There are no limiting factors or regulations that are likely to retard the development of additional oil fields. Hence, it is reasonably certain that development will continue to destroy and fragment kit fox habitat into the foreseeable future.

Road Effects: San Joaquin kit fox mortality and injury may occur when the animals attempt to cross roads and are hit by cars, trucks, or motorcycles. The majority of strikes likely occur at night when the animals are most active. Driver visibility also is lower at night increasing the potential for strikes. Such strikes are usually fatal for an animal the size of a kit fox. Thus, vehicle strikes are a direct source of mortality for the San Joaquin kit fox. If vehicle strikes are sufficiently frequent in a given locality, they could result in reduced kit fox abundance. The death of kit foxes during the November-January breeding season could result in reduced reproductive success. Death of females during gestation or prior to pup weaning could result in the loss of an entire litter of young, and therefore, reduced recruitment of new individuals into the population.

Occurrences of vehicle strikes involving San Joaquin kit foxes have been well documented, and such strikes occur throughout the range of the species. Sources of kit fox mortality were examined during 1980-1995 at the Naval Petroleum Reserves in California in western Kern County (Cypher et al. 2000). During this period, 341 adult San Joaquin kit foxes were monitored using radio telemetry, and 225 of these animals were recovered dead. Of these, 20 were struck by vehicles; 9 percent of adult kit mortalities were attributed to vehicles, and 6 percent of all monitored adults were killed by vehicles. During this same period, 184 juvenile (<1 year old) kit foxes were monitored. Of these, 142 were recovered dead and 11 were killed by vehicles; 8 percent of juvenile kit fox mortalities were attributed to vehicles and 6 percent of all monitored juveniles were killed by vehicles. For both adults and juveniles, vehicle strikes accounted for less than 10 percent of all San Joaquin kit fox deaths in most years. However, in some years, vehicles accounted for about 20 percent of deaths. Predators, primarily coyotes and bobcats, were the primary source of mortality at the Naval Petroleum Reserves. In addition, 70 kit foxes, both radio collared and non-collared, were found dead on roads in and around the Naval Petroleum Reserves during 1980-1991 (U.S. Department of Energy 1993). Of these, 34 were hit by vehicles on the approximately 990 miles (1,600 kilometers) of roads at the Reserve, and 36 were struck on the approximately 50 miles (80 kilometers) of State and County roads (e.g., State Route 119, Elk Hills Road), where traffic volumes and average vehicle speeds were higher. In western Merced County, 28 San Joaquin kit foxes were radio-collared during 1985-1987 (Briden et al. 1992). Seventeen were found dead and two (12 percent) of these deaths were attributed to vehicles. In the City of Bakersfield, 113 San Joaquin kit foxes were radio-collared and monitored during 1997-2000 (Cypher 2000). Thirty-five were recovered dead (123 adults and 12 pups); nine adults (39 percent) and six pups (50 percent) were attributed to vehicle strikes. At this urban site, coyotes and bobcats are rare, and vehicles are the primary source of kit fox mortality. However, survival rates are higher than rates among kit foxes in non-urban areas, and vehicles do not appear to be limiting the population size.

Vehicles constitute a consistent source of mortality for the kit fox, based on the frequency with which vehicle strikes occur. However, the precise effect of vehicle strikes on the San Joaquin kit fox has not been adequately investigated. According to Morrell (1970), "The automobile is by far the major cause of reported San Joaquin kit fox deaths - 128 of 152 deaths reported were caused by automobiles." Morrell acknowledged that the numbers were based on non-radio-collared kit foxes and therefore were biased because road-killed foxes are conspicuous and easily observed compared to animals dying from other causes. Predators such as coyotes, bobcats, non-native red foxes, and domestic dogs likely constitute a higher source of mortality than vehicle strikes (Service 1998; Cypher 2000). Vehicle-related mortality has significantly affected other listed or rare species. Vehicles caused 49 percent of the mortality documented among endangered Florida panthers (*Puma councilor coryi*) (Maehr et al. 1991). With a remaining population of 30-20 animals, the loss of any to vehicles likely constitutes a significant population effect. Similarly, at least 15 percent of the remaining 250-300 key deer (*Odocoileus virginianus clavium*) are killed annually by vehicles (Turbak 1999), and this mortality is considered to be a limiting factor for this endangered species (Service 1985). Mortality from vehicles was the primary source of mortality for endangered ocelots (*Felis pardalis*) in Texas (Turbak 1999), and also contributed to the failure of a lynx (*Lynx canadensis*) reintroduction project in New York (Aubrey et al. 1999). Rudolph et al. (1999) estimated that road-associated mortality may have depressed populations of Louisiana pine snakes (*Pituophis ruthveni*) and timber rattlesnakes (*Crotalus horridus*) by over 50 percent in eastern Texas, and this mortality may be a primary factor in local extirpations of timber rattlesnakes (Rudolph et al. 1999). Mortality from vehicles also is contributing to the reduction in the status of the prairie garter snake (*Thamnophis radix radix*) in Ohio (Dalrymple and Reichenbach 1984), and was a limiting factor in the recovery of the endangered American crocodile (*Crocodylus acutus*) in Florida (Kushland 1988). In Florida, threatened Florida scrub-jays (*Aphelocoma coerulescens*) suffered higher mortality in territories near roads, as well as reduced productivity due to vehicle strikes of both breeding adults and young (Mumme et al. 1999).

Noise Effects: Increase in the ambient noise level may significantly affect kit foxes. Although no specific research has been performed on this species, a "safe, short-term level" for humans has been determined to be 75 decibels (dBA) (NIH 1990; Burglund and Lindvall 1995). The mechanisms leading to permanent hearing damage are the same for all mammals (NIH 1990). However, the enlarged pinna and reduced tragi of kit foxes indicate that hearing is more acute than in humans (Jameson and Peeters 2004). Hearing loss in humans has been correlated with cognitive dysfunction (NIH 1990). However, variation in response to intense noise has been found to vary, in humans, by as much as 30 to 50 dBA between individuals (NIH 1990). Similar variation has been found in animals (NIH 1990). In humans, hearing loss was greater in males than females; however, this may be caused by environmental factors (NIH 1990). Also, younger animals have been shown to be more susceptible to noise-induced hearing loss (NIH 1990). The ability to habituate to noise appears to vary widely between species (NPS 1990). Typical construction machinery produces noise in the range of 75 dBA (arc-welder) to 85 dBA (bulldozer) (Burglund and Lindvall 1995). Long-term noise levels of 85 dBA are recognized to cause permanent hearing damage in humans (NIH 1990). Noise levels at 85 dBA have been correlated with hypertension in Rhesus monkeys (*Macaca fasicularis*) (Cornman 2001). Increased reproductive failure in laboratory mice (*Mus musculus*) was found to occur after a level of 82-85 dBA for one week (Cornman 2001). However, measurable loss of hearing was found to occur in chinchillas (*Chinchilla laniger*) at a sustained level of 70 dBA (Peters 1965). Hearing loss from motorcycle traffic has been documented for the kangaroo rat (*Dipodomys* spp.) (Bondello and Brattstrom 1979) and desert kangaroo rats (*Dipodomys deserti*) showed a significant reduction in reaction distance to the sidewinder (*Crotalus cerastes*) after exposure to 95 dBA (Cornman 2001). Other desert mammals appear to sustain the same effects (Bondello and Brattstrom 1979). Aircraft noise has produced accelerated heart-rates in pronghorn (*Antilocapra americana*), bighorn sheep (*Ovis canadensis*), and elk (*Cervus elaphus*) (MacArthur 1976; Workman et al. 1992; all in NPS 1994).

Hearing loss is correlated with distance from the source of the noise. At a level of 110 dBA, guinea pigs (*Cavia porcellus*) suffered long-term hearing loss at distances of 75 and 150 feet (46 meters), temporary loss at a distance of 300 feet (91.4 meters), and no measurable loss at 4,500 feet (1,372 meters) (Gonzales et al. 1970). In water, noise is reduced at a rate of 5 dBA for each doubling of the distance to the source (Komanoff & Shaw 2000). For example, noise measuring 20 dBA at 60 feet (18.3 meters) registers 15 dBA at 120 feet (36.6 meters). Harassment from long-term noise may cause kit foxes to eventually vacate areas of suitable habitat. California condors (*Gymnogyps californianus*) have been shown to abandon nesting sites in response to vehicle noise (Shaw 1970). Grizzly bears (*Ursus arctos*), mountain goats (*Oreamnos canadensis*), caribou (*Rangifer* spp.), and bighorn sheep (*Ovis* spp.) have been found to abandon foraging or calving grounds in response to aircraft noise (Chadwick 1973; McCourt et al. 1974; Ballard 1975; Krausman and Hervert 1983; Gunn et al. 1985; Bleich 1990; all in NPS 1994).

Rodenticides: Rodenticides pose a threat to kit foxes through direct or secondary poisoning. Kit foxes may be killed if they ingest rodenticide in a bait application, or if they eat a rodent that has consumed the bait. Even sub-lethal doses of rodenticides may lead to the death of these animals by impairing their ability to escape predators or find food. Rodenticides may also indirectly affect the survival of kit foxes by reducing the abundances of their staple prey species.

For example, the California ground squirrel, which is the staple prey of kit foxes in the northern portion of their range, was thought to have been eliminated from Contra Costa County in 1975, after extensive rodent eradication programs. Field observations indicated that the long-term use of ground squirrel poisons in this county severely reduced kit fox abundance through secondary poisoning and the suppression of populations of its staple prey (Orloff et al. 1986).

Kit foxes occupying habitats adjacent to agricultural lands are also likely to come into contact with insecticides applied to crops owing to runoff or aerial drift. Kit foxes could be affected through direct contact with sprays and treated soils, or through consumption of contaminated prey. Data from the California Department of Pesticide Regulation indicate that acephate, aldicarb, azinphos methyl, bendiocarb, carbofuran, chlorpyrifos, endosulfan, s-fenvalerate, naled, parathion, permethrin, phorate, and trifluralin are used within one-mile (1.6 kilometer) of kit fox habitat. A wide variety of crops (alfalfa, almonds, apples, apricots, asparagus, avocados, barley, beans, beets, bok choy, broccoli, cantaloupe, carrots, cauliflower, celery, cherries, chestnuts, chicory, Chinese cabbage, Chinese greens, Chinese radish, collards, corn, cotton, cucumbers, eggplants, endive, figs, garlic, grapefruit, grapes, hay, kale, kiwi fruit, kohlrabi, leeks, lemons, lettuce, melons, mustard, nectarines, oats, okra, olives, onions, oranges, parsley, parsnips, peaches, peanuts, pears, peas, pecans, peppers, persimmons, pimentos, pistachios, plums, pomegranates, potatoes, prunes, pumpkins, quinces, radishes, raspberries, rice, safflower, sorghum, spinach, squash, strawberries, sugar beets, sweet potatoes, Swiss chard, tomatoes, walnuts, watermelons, and wheat), as well as buildings, Christmas tree plantations, commercial/industrial areas, greenhouses, nurseries, landscape maintenance, ornamental turf, rangeland, rights of way, and uncultivated agricultural and non-agricultural land, occur in close proximity to San Joaquin kit fox habitat.

Efforts have been underway to reduce the risk of rodenticides to kit foxes (Service 1993). The Federal government began controlling the use of rodenticides in 1972 with a ban of Compound 1080 on Federal lands pursuant to Executive Order. Above-ground application of strychnine within the geographic ranges of listed species was prohibited in 1988. A July 28, 1992, biological opinion regarding the Animal Damage Control (now known as Wildlife Services) Program by the U.S. Department of Agriculture found that this program was likely to jeopardize the continued existence of the kit fox owing to the potential for rodent control activities to take the fox. As a result, several reasonable and prudent measures were implemented, including a ban on the use of M-44 devices, toxicants, and fumigants within the recognized occupied range of the kit fox. Also, the only chemical authorized for use by Wildlife Services within the occupied range of the kit fox was zinc phosphide, a compound known to be minimally toxic to kit foxes (Service 1993).

Despite these efforts, the use of other rodenticides still pose a significant threat to the kit fox, as evidenced by the death of 2 kit foxes at Camp Roberts in 1992 owing to secondary poisoning from chlorophacinone applied as a rodenticide, (Berry et al. 1992; Standley et al. 1992). Also, the livers of 3 kit foxes that were recovered in the City of Bakersfield during 1999 were found to contain detectable residues of the anticoagulant rodenticides chlorophacinone, brodifacoum, and bromadiolone (CDFG 1999).

To date, no specific research has been conducted on the effects of different pesticide or rodent control programs on the kit fox (Service 1998). This lack of information is problematic because Williams (in litt., 1989) documented widespread pesticide use in known kit fox and Fresno kangaroo rat habitat adjoining agricultural lands in Madera County. In a separate report, Williams (in litt., 1989) documented another case of pesticide use near Raisin City in Fresno County, where treated grain was placed within an active Fresno kangaroo rat (*Dipodomys nitratoides exilis*) precinct. Also, farmers have been allowed to place bait on Bureau of Reclamation property to maximize the potential for killing rodents before they entered adjoining fields (Biological Opinion for the Interim Water Contract Renewal, Service file 1-1-00-F-0056, February 29, 2000).

A September 22, 1993, biological opinion issued by the Service to the U.S. Environmental Protection Agency regarding the regulation of pesticide use (31 registered chemicals) through administration of the Federal Insecticide, Fungicide, and Rodenticide Act found that use of the following chemicals would likely jeopardize the continued existence of the kit fox: (1) aluminum and magnesium phosphide fumigants; (2) chlorophacinone anticoagulants; (3) diphacinone anticoagulants; (4) pival anticoagulants; (5) potassium nitrate and sodium nitrate gas cartridges; and (6) sodium cyanide capsules (Service 1993). Reasonable and prudent alternatives to avoid jeopardy included restricting the use of aluminum/magnesium phosphide, potassium/sodium nitrate within the geographic range of the kit fox to qualified individuals, and prohibiting the use of chlorophacinone, diphacinone, pival, and sodium cyanide within the geographic range of the kit fox, with certain exceptions (e.g., agricultural areas that are greater than one-mile [1.6 kilometer] from any kit fox habitat) (Service 1999).

Status of the Species: Habitat in the northern range is highly fragmented by highways, canals, and expanding urbanization. Interstate 580 runs southeast to northwest as it splits from I-5, and turns west through the Altamont Pass area; thereby impeding north-south and west-east movement of San Joaquin kit foxes. Although the canal system – California aqueduct and the Delta Mendota Canal – facilitates north-south migration along its length, it also impedes lateral east-west kit fox travel. Existing and future urbanization of Livermore and Dublin further impedes the movement of kit fox and isolates the northern extent of their range from southern core populations and diminishes the potential for recovery efforts in this region. Between 2000 and 2006, the City of Livermore experienced an 8.2% population increase, growing from 73,345 to 79,438 citizens (U.S. Census Bureau 2006). The City of Dublin grew by 39.2 % and the City of Pleasanton grew by 4% during this same period (U.S. Census Bureau 2006). Comparatively, the County of Alameda experienced a slower but steady rate of increase of 1.4%, which is a fifth of the State growth trend of 7.9% (U.S. Census Bureau 2006).

In the northern portion of their range, habitat loss is the primary cause of the decline of the kit fox. Most of the preferred valley bottom grassland and alkali scrub habitats in the northern range have been eliminated by agricultural, urban and industrial development (Service 1998). Between 2004 and 2006, 111 acres of farmland and 708 acres of grazing land in Alameda County were converted to new development, in part comprising 69 acres in the Altamont quad for residential and park development, 15 acres in each of the Livermore and Dublin quads for new homes, and 80 acres of new apartments in Livermore (California Department of Conservation 2006). This is comparable to the steady decline in the total acreage of farmland and grazing land in Alameda County, which experienced a net decrease of 16,721 acres from 1984 to 2006, and is consistent with the increasing trend of land converted to urban development totaling 18,590 net acres (California Department of Conservation 2006). Proposed land conversion continues to target large areas of San Joaquin kit fox habitat. One such project in Alameda County totals 700 acres (283 hectares) (East Bay Regional Parks District 2003). Other proposed projects located within the San Joaquin kit fox northern range include another 310-acre (125-hectare) project in Alameda County, two in San Joaquin County totaling 12,427 acres (5,029 hectares), and a 19-acre (7.7-hectare) project in Santa Clara County. San Joaquin kit fox are under increasing pressure from habitat conversion and urbanization, development (i.e., Dublin Ranch, Fallon Village, Fallon Sports Park, Staples Ranch, Shea Center Livermore, and Livermore Toyota), and infrastructure, utility and safety improvement projects (i.e., I-580 Eastbound HOV, I-580/Isabel Avenue Interchange, and I-580/Charro Avenue Interchange).

The kit fox recovery plan identifies several recovery actions to aid the overall population ecology and management. The plan includes: (1) protecting existing suitable habitat on private and public lands to ensure the establishment of viable metapopulations throughout its large geographic range including Contra Costa and Alameda counties; (2) determining habitat restoration and management prescriptions that focus on factors that promote populations of prey species along with determining the direct and indirect effects and economic costs and benefits of rodent and rabbit control programs on kit foxes; (3) and protect existing kit fox habitat in the northern, northeastern, and northwestern segments of their geographic range and existing connections between habitat in those areas and habitat further south.

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

A total of 15 San Joaquin kit fox dens and sightings have been reported within Alameda County and 25 within Contra Costa County between 1973 and 2008 (CDFG 2009). Five of these occurrences have been reported within the last ten years; four in Alameda County (*i.e.*, near Sunol, Brushy Peak, and Bethany Reservoir) and one in Contra Costa County. The latter was reported by Contra Costa Water Department (CCWD) Assistant Watershed Resource Specialist John Howard on September 6, 2008 located near the CCWD office at the Los Vaqueros Reservoir (Mark Mueller pers. comm. 2008). Dispersal of San Joaquin kit fox from the Ciervo-Panoche Natural Area core population in Merced County into the northern portion of the range, a distance of approximately 70 miles, is threatened by land conversion, habitat fragmentation (*i.e.*, Interstates 5, 580 and 205), vehicle strikes, rodenticide usage, predation, and competitive exclusion (Service 1998). Surveys in Contra Costa and Alameda counties have shown that although suitable habitat exists, kit foxes in this area are rare and difficult to detect, as they are in other portions of the current range where sightings are infrequent.

Environmental Baseline

The action area is within the range of San Joaquin kit fox and supports habitat suitable for all life history stages including extensive grasslands with connectivity for dispersal and movement to larger, undeveloped land tracts of suitable grasslands to the west and north. The nearest reported occurrences are located (1) 1.7 miles to the north of the I-580/Tassajara Road intersection in 1975 (Occ. #1031), (2) 2.3 miles to the southeast of the I-580/Greenville Road intersection comprising two adults and two juveniles at a den in 1989 (Occ. #43) along South Flynn Road, and (3) 3.4 miles to the north of the I-580/Greenville Road intersection consisting of one adult east of Brushy Peak (Occ. #58) observed in 2002. Ground squirrels, California meadow voles (*Microtus californicus*), Botta's pocket gophers, broad-footed moles (*Scapanus latimanus*) and a variety of grassland birds and invertebrates inhabit much of the undeveloped lands within the action area, which provide an abundant prey resource and whose burrows are easily excavated for denning use by kit fox. The majority of the unpaved area to be affected is along the road verge and exhibits varying levels of disturbance; however, this habitat supports a sustainable prey base and facilitates daily movement and dispersal of kit fox. The Service has determined that the San Joaquin kit fox is reasonably certain to occur within the action area based on the biology and ecology of the animal, the presence of suitable habitat in and adjacent to the action area, as well as the nearby observations of this species.

Effects of the Action

Vernal Pool Fairy Shrimp

The proposed project will likely adversely affect the threatened vernal pool fairy shrimp by harming individual fairy shrimp cysts during the removal of soil and installation of the retaining wall, which will be constructed through the southernmost 0.013-acre of Seasonal Wetland 1. Dormant cysts, which remain viable in the soils lining wetlands throughout the dry season, may become entombed under soil, crushed or damaged by equipment or personnel during construction of the retaining wall, or exposed to toxins, chemicals or other injurious substances from accidental spills or leaky construction equipment. Caltrans proposes to partially minimize these effects by limiting work within Seasonal Wetland 1 to the dry season from April 15 to October 15, and delaying the onset of construction within this work window until the soils are completely dry. This work window will avoid disrupting the active breeding period, harming the adult life history stage, and adversely affecting the remaining portion of the wetland. Caltrans also proposes to extend the two pipe culverts through the retaining wall so as not to alter the existing drainage patterns or affect the existing functionality of the wetland. Given that the surface water hydrology which flows into the wetland from lands north of I-580 and exit the wetland through the culverts to the south, the project will not alter the hydrology or function of wetland.

During construction, vernal pool fairy shrimp may be exposed to toxins, chemicals or other injurious substances from accidental spills or leaky construction equipment, thereby resulting in harm or mortality to individual cysts. Caltrans proposes to minimize this risk by implementing a Storm Water Pollution Prevention Plan, erosion control Best Management Practices and a Spill Response Plan, which will consist of refueling, oiling or cleaning of vehicles and equipment a minimum of 50 ft away from the wetland; installing coir rolls, straw wattles and/or silt fencing to capture sediment and prevent runoff or other harmful chemicals from entering the wetland; locating staging, storage and parking areas away from the wetland, and enclosing all trash in sealed trash containers and removing them from the site at the end of each day. Adverse effects will be further minimized by erecting construction fencing to keep construction workers from straying outside the designated work zone and disturbing additional habitat and/or species; educating workers about the presence of vernal pool fairy shrimp, their habitat, identification, regulatory laws, and avoidance and minimization measures; and requiring a Service-approved biologist to be present to monitor project activities within or adjacent to Seasonal Wetland 1.

The proposed action will result in the permanent loss of 0.013-acre of vernal pool fairy shrimp habitat. This comprises 2.12% of the 0.613-acre of Seasonal Wetland 1, and although it will not affect the function or hydrology of the wetland, it will result in a net loss of habitat and the take of all cysts inhabiting the 0.013-acre portion as a result of the habitat loss. Caltrans has proposed a compensatory habitat conservation measure to provide minimization for the effects on the vernal pool fairy shrimp at a ratio of 1:1.

California Red-legged Frog and California Tiger Salamander

The proposed project will likely adversely affect the threatened California red-legged frog by killing, harming and/or harassing tadpoles, juveniles and adults inhabiting areas of suitable aquatic and upland habitat between Springtown Blvd. in the City of Livermore and the Dublin/Pleasanton BART station in the City of Dublin. The aspects of the proposed action most likely to affect the California red-legged frog are largely confined to the construction phase of the project and include 1) the construction of an auxiliary lane between First Street and North

Livermore Interchanges inclusive of the ramp noses at I-580/First Street/Springtown Blvd. interchange area, widening the bridge in the eastbound and westbound directions over Arroyo Las Positas west of Las Colinas Road, extending the existing box culvert at Arroyo Seco Creek along the westbound direction, installing a retaining wall at Seasonal Wetland 1; 2) construction of an auxiliary lane along I-580 westbound from the North Livermore Avenue on-ramp to Portola Avenue on-ramp inclusive of the I-580/Northern Livermore Ave. interchange area, bridge widening in the eastbound and westbound directions over Arroyo Las Positas near the confluence with Cayetano Creek; 3) widening of westbound I-580 from the Portola Avenue on-ramp to Airway Blvd. inclusive of widening the bridge in the westbound direction only over Arroyo Las Positas; 4) widening of westbound I-580 from the Fallon Road Interchange to Tassajara Road inclusive of the widening of the bridge in the eastbound and westbound directions over Tassajara Creek; and 5) widening of westbound I-580 from Hacienda Drive to the Dublin/Pleasanton BART station.

The proposed project will likely adversely affect the threatened Central Valley DPS California tiger salamander by killing, harming and/or harassing juveniles and adults inhabiting grasslands and ruderal habitat supporting suitable underground refugia between Springtown Blvd. in the City of Livermore and Tassajara Road in the City of Dublin within or adjacent to undeveloped lands. The aspects of the proposed action most likely to affect the California tiger salamander are largely confined to the construction phase of the project and include 1) the construction of an auxiliary lane between First Street and North Livermore interchanges inclusive of the widening the bridge in the eastbound and westbound directions over Arroyo Las Positas west of Las Colinas Road, extending the existing box culvert at Arroyo Seco Creek along the westbound direction, installing a retaining wall installation at Seasonal Wetland 1; and 2) construction of an auxiliary lane along I-580 westbound from the North Livermore Avenue on-ramp to Portola Avenue on-ramp inclusive of the I-580/Northern Livermore Ave. interchange area, bridge widening in the eastbound and westbound directions over Arroyo Las Positas near the confluence with Cayetano Creek; 3) widening of westbound I-580 from the Portola Avenue on-ramp to Airway Blvd. inclusive of widening the bridge in the westbound direction only over Arroyo Las Positas; and 4) widening of westbound I-580 from the Fallon Road Interchange to Tassajara Road inclusive of the widening of the bridge in the eastbound and westbound directions over Tassajara Creek.

Construction noise, vibration, night-lighting, and increased human activity may interfere with normal behaviors – feeding, sheltering, movement between refugia and foraging grounds, and other essential behaviors of the California red-legged frog and California tiger salamander – resulting in avoidance of areas that have suitable habitat but intolerable levels of disturbance; forcing individuals from cover thereby subjecting them to predation that otherwise would not occur; or reducing natural food sources as a result of habitat disturbance and loss. Short-term temporal effects will occur when vegetative cover is removed along riparian corridors and within upland habitat during project construction, which may subject these species to an increased risk of predation.

The proposed construction activities could result in the introduction of chemical contaminants to the site. Substances used in road building materials could leach out or wash out of the soil into adjacent habitat. Vehicles may leak hazardous substances such as motor oil and antifreeze. A variety of substances could be introduced during accidental spills of materials. Such spills can result from leaks in vehicles, small containers falling off vehicles, or from accidents resulting in whole loads being spilled. Frogs and salamanders using these areas could be exposed to any contaminants that are present at the site. Exposure pathways could include inhalation, dermal contact, direct ingestion, or ingestion of contaminated soil or plants. Exposure to contaminants could cause short- or long-term morbidity, possibly resulting in reduced productivity or mortality. Carcinogenic substances could cause genetic damage resulting in sterility, reduced productivity, or reduced fitness among progeny. Little information is available on the effects of contaminants on these species and the effects may be difficult to detect. Morbidity or mortality likely would occur after the animals had left the contaminated site, and more subtle effects such as genetic damage could only be detected through intensive study and monitoring. Caltrans proposes to minimize these risks by implementing a Storm Water Pollution Prevention Plan (SWPPP), erosion control Best Management Practices (BMP) and a Spill Response Plan, which will consist of refueling, oiling or cleaning of vehicles and equipment a minimum of 50 ft away from the wetland; installing coir rolls, straw wattles and/or silt fencing to capture sediment and prevent runoff or other harmful chemicals from entering the wetland; and locating staging, storage and parking areas away from aquatic habitats.

Preconstruction surveys and the relocation of individual California red-legged frogs and California tiger salamanders may avoid injury or mortality; however, capturing and handling frogs may result in stress and/or injury due to improper handling, containment, and transport. Death and injury of individuals could occur at the time of relocation or later in time subsequent to their release. Although survivorship for translocated amphibians has not been estimated, survivorship of translocated wildlife, in general, is lower because of intraspecific competition, lack of familiarity with the location of potential breeding, feeding, and sheltering habitats, risk of contracting disease in foreign environment, and increased risk of predation. These effects will be minimized through the use of a qualified Service-approved biologist, limiting the duration of handling, and relocating amphibians to similar, nearby habitat.

Biologists, construction workers, and construction equipment working in different areas and with different species may transmit diseases by introducing contaminated equipment. The chance of a disease being introduced into a new area is greater today than in the past due to the increasing occurrences of disease throughout amphibian populations in California and the United States. It is possible that chytridiomycosis, caused by chytrid fungus (*Batrachochytrium dendrobatidis*), may exacerbate the effects of other diseases on amphibians or increase the sensitivity of the amphibian to environmental changes (e.g., water pH) that reduce normal immune response capabilities (Bosch et al. 2001, Weldon *et al.* 2004). Implementing proper decontamination procedures prior to and following aquatic surveys and handling of frogs and salamanders will minimize the risk of transferring diseases through contaminated equipment or clothing.

Soil disturbing activities and vegetation removal can facilitate the invasion and establishment by species not native to the area (Gelbard and Belnap 2003), such as the bullfrog or are native and are better competitors than the California red-legged frog and California tiger salamander that could feed on or compete with, these species or their food sources. Disturbance and alteration of habitat adjacent to roads and newly paved areas may create favorable conditions for non-native plants and animals. These exotic species can spread along roadsides and then into adjacent habitat. Non-native animals may use modified habitats adjacent to roads to disperse into frog and salamander habitat. These animals could compete with the listed ranid for resources such as food or cover, or directly injure or kill these amphibians. Non-native plants and animals may reduce habitat quality, and reduce the productivity or the local carrying capacity for the animals. Introductions of non-native species could cause California red-legged frogs and California tiger salamanders to alter behavioral patterns by avoiding or abandoning areas near roads or pavement.

Disturbed areas adjacent to roads and pavement provide favorable habitat conditions for a number of non-native plant species. Some of these taxa are aggressively invasive and they can alter natural communities and potentially affect habitat quality. A problematic species within the range of these amphibians is 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 the animals to move through due the plant's numerous sharp spines. Other species that may disperse along roads and invade adjacent riparian habitats include mustards (*Brassica* spp.) and Russian thistle (*Salsola tragus*) (Tellman 1997). Nitrogen from vehicle exhaust is deposited in habitats adjacent to roads, and the resulting enhanced nitrogen levels appear to promote growth of non-native species, particularly exotic grasses (Weiss 1999). These grasses, such as red brome (*Bromus madritensis rubens*) create dense ground cover in the San Joaquin Valley, and this dense cover appears to reduce habitat quality for various small mammal species, such as kangaroo rats, which are an important prey for kit foxes (Goldingay et al. 1997; Cypher 2000). Disturbed soils and reduced competition from native plants are some of the conditions that facilitate invasion along roads by non-native plant species. Post-construction restoration of denuded and disturbed work areas will likely provide some degree of habitat for California red-legged frogs and California tiger salamanders in the future and will minimize erosion during the short-term.

Temporary effects comprise areas denuded, manipulated, or otherwise modified from their existing, pre-project conditions thereby removing one or more essential components of a listed species' habitat as a result of project activities that include, but are not limited to, construction, staging, storage, lay down, vehicle access, parking, etc. Temporary effects must be restored to baseline habitat values or better within one year following initial disturbance. Areas subjected to ongoing operations and maintenance are not considered temporary even if they are restored within one year following initial disturbance. Affected areas not fulfilling these criteria are considered permanent. The configuration and bridge types will be consistent with the existing structures at the four creek crossings and will require driving piles into the substrate to construct additional bridge support columns. Constructing the bridge and culvert extensions will require the disruption of substrate, diversion of water flow, and installation of permanent structures within the bed and banks of Arroyo Las Positas, Arroyo Seco and Tassajara creeks and will require more than one year to complete. This would result in the permanent loss and/or degradation of 0.73-acre of California red-legged frog breeding and foraging aquatic habitat. Construction of a retaining wall at Seasonal Wetland 1 would result in the permanent loss and degradation of 0.013-acre of suitable California tiger salamander breeding and larval rearing habitat. These effects will be partially minimized by limiting work to the dry season, from April 15 to October 15, which will avoid disrupting breeding activities. However, construction within aquatic habitats is likely to result in mortality or injury to individual tadpole, juvenile and adult California red-legged frogs and juvenile and adult California tiger salamanders by becoming entombed under soil, or crushed, injured or harassed by equipment or personnel.

Construction within terrestrial habitat would result in the permanent loss and/or degradation of 19.39 acres of upland California red-legged frog habitat, which may adversely affect foraging, sheltering and dispersing juvenile and adult frogs within the action area. Construction of auxiliary lanes, retaining walls, modifications to intersections and bridge expansions would result in the permanent loss and/or degradation of 8.55 acres of upland California tiger salamander habitat, which may adversely affect aestivating, foraging and dispersing juvenile and adult salamanders within the action area, since they use small mammal burrows and soil crevices for shelter and aestivation outside of their breeding season. Upland habitat within the action area provides a link between existing frog populations within Arroyo Las Positas, Arroyo Seco, Cayetano and Tassajara creeks, and other nearby populations to the north and east. Frogs and salamanders in terrestrial habitat may also become entombed under soil, crushed or damaged by equipment or personnel, thereby resulting in harm or mortality to individual frogs. Adverse effects will be partially minimized by erecting construction fencing to keep construction workers from straying outside the designated work zone and disturbing additional habitat and/or species; educating workers about the presence of California red-legged frogs and California tiger salamanders, their habitat, identification, regulatory laws, and avoidance and minimization measures; and requiring a Service-approved biologist to be present to monitor project activities within or adjacent to suitable habitat.

The permanent loss and/or degradation of: 1) 0.73-acre of California red-legged frog breeding and year-round aquatic habitat, 2) 19.39 acres of California red-legged frog upland foraging, sheltering and dispersal habitat, 3) 0.013-acre of California tiger salamander breeding and larval rearing habitat, and 4) 8.55 acres of California tiger salamander upland aestivation, foraging and dispersal habitat, will result in the take of all frogs and salamanders within these areas as a direct result of habitat loss. Caltrans has proposed a compensatory habitat conservation measure to provide minimization for the effects on the California red-legged frog and California tiger salamander at a ratio of 1:1.

San Joaquin Kit Fox

The proposed project will likely adversely affect the endangered San Joaquin kit fox through harm and harassment of individual juveniles and adults. Due to existing development along the project corridor, the effects to San Joaquin kit fox habitat will be limited to the grassland and ruderal habitat from Dougherty Road eastward to the project terminus near North Greenville Road. The aspects of the proposed action most likely to affect the kit fox are largely confined to the construction phase of the project and include 1) construction of HOV bypass lanes at the eastbound and westbound on-ramps at Greenville Road, Vasco Road, First Street, and North Livermore Avenue; and the westbound on-ramp at Airway Boulevard; 2) construction of an auxiliary lane along I-580 westbound between the Vasco Road and First Street interchanges, 3) the construction of an auxiliary lane between First Street and North Livermore Interchanges inclusive of the ramp noses at I-580/First Street/Springtown Blvd. interchange area, widening the bridge in the eastbound and westbound directions over Arroyo Las Positas west of Las Colinas Road, extending the existing box culvert at Arroyo Seco Creek along the westbound direction, installing a retaining wall at Seasonal Wetland 1; 4) construction of an auxiliary lane along I-580 westbound from the North Livermore Avenue on-ramp to Portola Avenue on-ramp inclusive of the I-580/Northern Livermore Ave. interchange area, bridge widening in the eastbound and westbound directions over Arroyo Las Positas near the confluence with Cayetano Creek; 5) widening of westbound I-580 from the Portola Avenue on-ramp to Airway Blvd. inclusive of widening the bridge in the westbound direction only over Arroyo Las Positas; 6) widening of westbound I-580 from the Fallon Road Interchange to Tassajara Road inclusive of the widening of the bridge in the eastbound and westbound directions over Tassajara Creek; and 7) widening of westbound I-580 from Hacienda Drive to the Dublin/Pleasanton BART station.

Disturbed areas adjacent to roads provide favorable habitat conditions for a number of non-native plant species. Some of these taxa are aggressively invasive and can alter natural communities and potentially affect habitat quality. A problematic species within the range of the San Joaquin kit fox is 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 and competes with native plants for resources. It also does not appear to be used by kit fox prey and star thistle often forms dense, spiny thickets that may be difficult for kit foxes to move through (Cypher 2000). Other invasive plant species that often benefit from road-side disturbance include mustards (*Brassica* spp.) and Russian thistle (*Salsola tragus*) (Tellman 1997). Nitrogen from vehicle exhaust is deposited in habitats adjacent to roads, and the resulting enhanced nitrogen levels appear to promote growth of non-native species, particularly exotic grasses (Weiss 1999). These grasses, such as red brome (*Bromus madritensis rubens*) create dense ground cover in the San Joaquin Valley, and this dense cover appears to reduce habitat quality for various small mammal species, such as kangaroo rats, which are an important prey for kit foxes (Goldingay et al. 1997; Cypher 2000). Disturbed soils and reduced competition from native plants are some of the conditions that facilitate invasion along roads by non-native plant species. Post-construction restoration of denuded and disturbed work areas will likely provide some degree of habitat for kit fox in the future and will minimize erosion during the short-term.

Disturbance caused by the proposed action resulting from construction noise, vibration, odors, and human activity can interfere with sensory perception decreasing their ability to locate prey, pups, or mates, or detect approaching predators. Disturbance can induce stress which can result in adverse physiological conditions and alter normal behaviors. The resulting effects can lead to increased energetic requirements, decreased reproductive success and immunological functions, altered temporal or spatial use patterns, displacement, and in some cases death. Responses to external stresses vary among individuals, causing some animals to be more affected than others; however, it is unknown whether disturbance results in reduced local abundance. Project effects on the San Joaquin kit fox are expected to be greater during the den selection, pregnancy, and early pup dependency periods of the breeding cycle (December through July) than at other times of the year.

The proposed action could result in the introduction of chemical contaminants to the action area through accidental spills, careless maintenance or operation of vehicles and equipment, unauthorized refueling, leaks, etc. Substances used in project construction could leach out or wash off construction equipment, vehicles and/or supplies into kit fox habitat within the action area. Exposure pathways include inhalation, dermal contact, direct ingestion, or consumption of contaminated prey. Exposure pathways could include inhalation, dermal contact, direct ingestion, or ingestion of contaminated soil or plants. Exposure to contaminants could cause short- or long-term morbidity, possibly resulting in reduced productivity or mortality. Carcinogenic substances could cause genetic damage resulting in sterility, reduced productivity, or reduced fitness among progeny. Contaminants could result in reduced prey abundance and diminished local carrying capacity for the kit fox. Vehicle exhaust emissions can include hazardous substances which may concentrate in soils along I-580. Heavy metals such as lead, aluminum, iron, cadmium, copper, manganese, titanium, nickel, zinc, and boron are all emitted in vehicle exhaust (Trombulak and Frissell 2000). Concentrations of organic pollutants (e.g., Dioxins, polychlorinated biphenyls) are higher in soils along roads (Benfenati et al. 1992). Vehicles may leak hazardous substances such as motor oil and antifreeze. Although the quantity leaked by a given vehicle may be minute, these substances can accumulate on I-580 and then get washed into the adjacent kit fox habitat by runoff during rain storms. The effects may be difficult to detect. Morbidity (signs of harm) or mortality (death) would likely occur after the animals had left the contaminated site, and more subtle effects such as genetic damage could only be detected through intensive study and monitoring. Caltrans proposes to minimize these risks by implementing a Storm Water Pollution Prevention Plan (SWPPP), erosion control Best Management Practices (BMP) and a Spill Response Plan, which will consist of refueling, oiling or cleaning of vehicles and equipment a minimum of 50 ft away from the wetland; installing coir rolls, straw wattles and/or silt fencing to capture sediment and prevent runoff or other harmful chemicals from entering the wetland; and locating staging, storage and parking areas away from aquatic habitats.

Vehicles constitute a consistent, but variable source of mortality for the animal, based on the frequency with which vehicle strikes occur. Vehicle strikes appear to occur most frequently where roads transverse areas where the animals are abundant. However, the linear quantity of roads in a given area may not be directly related to the number of vehicle strikes in a given area. The type of road (e.g., number of lanes) traffic volume, and average speed of vehicles likely all influence the number of San Joaquin kit fox/vehicle strikes. The number of strikes likely increases with road size, traffic volume, and average speed (Clevenger and Waltho 1999). Another factor influencing the number of vehicles striking this endangered mammal, but for which little data is available, is the frequency with which the animals cross roads and are therefore at risk. The proportion of successful road crossings by these animals likely declines with increasing road size, traffic volume and density, and vehicle speeds. The proportion of San Joaquin kit foxes successfully crossing roads may increase in areas where they obtain more experience crossing roads, such as in and near urban areas. The loss of kit fox to vehicles may constitute a significant population effect within their northern range where they occur in low abundance. Morrell (1970) reported vehicle strikes to be the major cause of death for kit foxes based on study in which 128 of 152 deaths were reportedly caused by automobiles. In the City of Bakersfield, 35 of 113 radio-collared San Joaquin kit foxes during 1997-2000 were reported to have died in response to motor vehicle strikes (Cypher 2000). In a radio collar study of two-lane roads in the Lokern Natural Area west of Bakersfield, Cypher *et al.* (2005), reported only one of 69 radio collared kit fox died due to vehicle strikes and suggested that two-lane roads may not pose a significant threat to kit fox survival. Within eastern Alameda County, EIP Associates (CNDDB Occ. #585) reported a kit fox along Interstate 205 near the Alameda/San Joaquin County line in 1986; Spencer (CNDDB Occ. #41) reported a single adult running along Kelso Road on June 20, 1992; and Beeman (CNDDB Occ. #39) reported a single adult kit fox crossing Patterson Pass Road on June 23, 1995. This evidence suggests that kit fox utilize habitat along rural roads and highways, increasing their susceptibility to mortality or injury caused by vehicle strikes.

Roads have been documented as barriers to movements by a variety of species, and this effect varies with road size and traffic volume. Bobcats (*Felis rufus*) in Wisconsin readily crossed dirt roads, but were reluctant to cross paved roads (Lovallo and Anderson 1996). Lynx also exhibit a reluctance to cross roads (Barnum 1999) as do mountain lions (*Felis concolor*) (Van Dyke et al. 1986). In a study in North Carolina, the number of road crossings by black bears (*Ursus americanus*) was inversely related to traffic volume, and bears almost never crossed an interstate highway (Brody and Pelton 1989). The inhibition of animal movements caused by roads produces a significant effect by fragmenting habitats and populations (Joly and Morand 1997). Knapp (1978) monitored movements of radio-collared San Joaquin kit foxes in the vicinity of Interstate 5 in Kern County. Many of the foxes used areas within 2 miles of the highway, and most exhibited movement and home range patterns that parallel the highway, but did not cross it. Only on 2 occasions were animals located on the opposite side of the highway from their primary area of use. Interstate 580 likely has a similar effect on kit fox in Alameda County. Fortunately, the majority of habitat south of Interstate 580 comprises unsuitable, urbanized habitat, which reduces the effects of habitat fragmentation and impermeable barriers. The widening of Interstate 580 will not significantly increase the barrier effect due to the existing high traffic loads, which ranged from 142,000 to 196,000 vehicles per day in 2003 (Caltrans 2003), even though Caltrans

(2008) anticipates the traffic load to increase by 43% by 2025. Widening of the four bridges would temporary block daily movement or dispersal corridors.

Fragmentation factors that effectively isolate patches and limit access also constitute barriers to San Joaquin kit fox movements, dispersal, and gene flow. Movements and dispersal corridors are critical to kit fox population dynamics, particularly because the animals currently persist as metapopulations with multiple disjunct population centers. Movement and dispersal corridors are important for alleviating over-crowding and intraspecific competition during years when San Joaquin kit fox abundance is high, and also they are important for facilitating the recolonization of areas where the animal has been extirpated. Movement between population centers maintains gene flow and reduced genetic isolation. Genetically isolated populations are at greater risk of deleterious genetic effects such as inbreeding, genetic drift, and founder effects. Range-wide habitat loss, fragmentation, and degradation from multiple factors are the primary threat to the San Joaquin kit fox (Service 1998). In California, local extirpations of mountain lions occurred when roads and other developments fragmented habitat in small patches and blocked movement corridors thereby isolating the patches and preventing recolonization (Beier 1993). Adequately sized culverts or undercrossings with suitable habitat at each side of the passage significantly increases the ability of mammals to safely cross highways (Ng et al. 2003). The four bridges across Arroyo Las Positas and Tassajara Creek currently provide a means for wildlife to safely cross under Interstate 580. Widening of these four bridges will not diminish the utility of these structures as wildlife conveyances, since the majority of these provide clear, wide openings that accommodate animal movement.

The Proposed Conservation Measures outlined in the Biological Assessment will minimize adverse effects to the San Joaquin kit fox by requiring a qualified Service-approved biologist to be present to monitor project activities within or adjacent to areas designated as suitable kit fox habitat; educating workers about the presence of San Joaquin kit fox, their habitat, identification, regulatory laws, and avoidance measures; erecting deterrent fencing to minimize the likelihood a kit foxes entering the construction area; installing construction fencing to keep construction workers from straying outside of the project footprint and disturbing additional habitat and/or species; covering all steep-walled holes or trenches more than 2 feet deep at the end of each workday; disposing of all food-related trash items in closed containers and removing from the action area daily; inspecting all den-like structures such as pipes or culverts prior to being buried, capped or moved; restricting the presence of firearms within the action area to law enforcement personnel; prohibiting bringing domestic animals to the action area; minimize erosion and the spread of invasive species; outline emergency actions and preventative measures for spills, refueling, fires, and other deleterious activities; and restoring habitat disturbed during construction to pre-project conditions or better.

Project activities within terrestrial habitat in association with the construction of auxiliary and HOV lanes, retaining walls, modifications to intersections and bridge expansions will result in the permanent loss and/or degradation of 21.21 acres of San Joaquin kit fox habitat within their northern range. The loss of habitat will result in take through the harm, harassment or mortality of kit fox inhabiting the 21.21 acres within the action area. Caltrans has proposed a compensatory habitat conservation measure to provide minimization for the effects on the San Joaquin kit fox at a ratio of 1:1.

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

Numerous non-Federal activities may negatively affect vernal pool fairy shrimp, California red-legged frog, California tiger salamander and/or San Joaquin kit fox in the action area through the displacement and fragmentation of habitats and populations, alteration of hydrological regimes, contamination, erosion, sedimentation, disruption of migration or dispersal corridors, changes in water quality, the introduction or promotion of predators, competitors and invasive species (Caltrans 2009). Future local development projects reasonably certain to occur include:

Project Name	Jurisdiction	Proposed Uses	Status
The Green at Park Place Retail Center	Dublin	305,000-square-foot retail commercial shopping center	Under planning review
Dublin Ranch	Dublin	Residential commercial and office mixed-use neighborhood	Some residential elements approved; commercial and office uses on hold
Staples Ranch	Pleasanton	Master development plan for mixed-use area with residential, commercial, industrial and community park uses	Phased project; EIR released for some elements; not yet approved
Kolb Ranch	Pleasanton	14-unit residential project	Approved- first building permits issued
Barbara Young	Pleasanton	3-unit residential expansion	Pending approval
Windstar Communities	Pleasanton	350-unit residential mixed-use transit-oriented development	Pending approval
El Charo Specific Plan	Livermore	Residential mixed-use with outlet shops	Final EIR prepared; final project approvals pending

Source: I-580 Westbound HOV Lane Project Initial Study with Proposed Mitigated Negative Declaration/ Environmental Assessment. March 2009.

The global average temperature has risen by approximately 0.6 degrees centigrade during the 20th Century (International Panel on Climate Change 2001, 2007; Adger et al 2007). There is an international scientific consensus that most of the warming observed has been caused by human activities (International Panel on Climate Change 2001, 2007; Adger et al. 2007), and that it is "very likely" that it is largely due to increasing concentrations of greenhouse gases (carbon dioxide, methane, nitrous oxide, and others) in the global atmosphere from burning fossil fuels and other human activities (Cayan 2005, EPA Global Warming webpage http://yosemite. epa.gov; Adger et al. 2007). Eleven of the twelve years between 1995 and 2006 rank among the twelve warmest years since global temperatures began in 1850 (Adger et al. 2007). The warming trend over the last fifty years is nearly twice that for the last 100 years (Adger et al. 2007). Looking forward, under a high emissions scenario, the International Panel on Climate Change estimates that global temperatures will rise another four degrees centigrade by the end of this Century; even under a low emissions growth scenario, the International Panel on Climate Change estimates that the global temperature will go up another 1.8 degrees centigrade (International

Panel on Climate Change 2001). The increase in global average temperatures affects certain areas more than others. The western United States, in general, is experiencing more warming than the rest of the Nation, with the 11 western states averaging 1.7 degrees Fahrenheit warmer temperatures than this region's average over the 20th Century (Saunders et al. 2008). California, in particular, will suffer significant consequences as a result of global warming (California Climate Action Team 2006). In California, reduced snowpack will cause more winter flooding and summer drought, as well as higher temperatures in lakes and coastal areas. The incidence of wildfires in the Golden State also will increase and the amount of increase is highly dependent upon the extent of global warming. No less certain than the fact of global warming itself is the fact that global warming, unchecked, will harm biodiversity generally and cause the extinction of large numbers of species. If the global mean temperatures exceed a warming of two to three degrees centigrade above pre-industrial levels, twenty to thirty percent of plant and animal species will face an increasingly high risk of extinction (International Panel on Climate Change 2001, 2007). The mechanisms by which global warming may push already imperiled species closer or over the edge of extinction are multiple. Global warming increases the frequency of extreme weather events, such as heat waves, droughts, and storms (International Panel on Climate Change 2001, 2007; California Climate Action Team 2006; Lenihan et al. 2003). Extreme events, in turn may cause mass mortality of individuals and significantly contribute to determining which species will remain or occur in natural habitats. Ongoing global climate change (Anonymous 2007; Inkley et al. 2004; Adger et al. 2007; Kanter 2007) likely imperils the delta smelt 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 the vernal pool fairy shrimp, California red-legged frog, Central Valley DPS California tiger salamander and San Joaquin kit fox; the environmental baseline for the action area; the effects of the proposed Interstate 580 Westbound HOV Lane Project and the cumulative effects; it is the Service's biological opinion that the project, as proposed, is likely to adversely affect all four species, but is not likely to jeopardize their continued existence. This determination is based on our opinion that the magnitude of the effects of this action does not appreciably reduce the likelihood of both the survival and recovery of these species in the wild.

Implementation of the project as proposed will incidentally take all four species through the active conversion and subsequent permanent loss of habitat supporting individuals of each species. When incidental take of individuals results from conversion and loss of habitat, there is no way in which to minimize the loss of those individuals. The use of compensatory habitat provides an alternative to minimizing take of individuals, by minimizing the overall effect of this take on the species. Caltrans has proposed a compensatory habitat conservation measure to provide this minimization, at a ratio of 1:1 (acres of compensation to acres of habitat loss) for all four species. The Caltrans proposal, taken directly from the BA, states:

> To offset permanent effects to vernal pool fairy shrimp, California red-legged frog, California tiger salamander, and San Joaquin kit fox, suitable habitat for each species, or suitable multi-species habitat in coordination with the Service, will be created, restored,

or set aside in perpetuity (Table 1). Alternatively, credits will be purchased at a Service-approved conservation bank.

The Service finds this proposal lacks sufficient detail to explain how it is expected to adequately minimize the effect on the four species from the anticipated level of take:

- Caltrans has not provided any specific information regarding where, how, or when such habitat compensation will occur for any of the four affected species, all of which have bearing on how much compensation will minimize project effects.

- The proposal is unclear as to whether the 'in perpetuity' phrase would also apply to created or restored habitat.

- Unless new habitat is successfully created and occupied where none existed before, or previously suitable habitat is successfully restored and occupied by the species, a compensation ratio of 1:1 represents a 50% rate of habitat loss for the species, relative to what currently exists.

The creation of new species habitat or restoration of prior habitat, actions which have been demonstrated to be successful in some cases for some species, also carry much uncertainty. There is an uncertainty associated with the creation of habitat with regards to the complex interactions between the biotic and abiotic factors that define the suitability of habitat for a particular species and the long-term viability of a new population. Creation/restoration also does not address the temporal loss of the species between the time the habitat is removed and the time it takes for the created habitat to become fully functional and occupied by the species.

Regarding the last bulleted item, it is important to remember that all ratios of habitat compensation using the preservation of existing habitat merely represent varying rates of overall permanent habitat loss. Using a ratio of 19:1, 5% of existing habitat is lost, 3:1 represents a 25% loss, while 1:1 results in a 50% loss. While protecting the compensatory habitat in perpetuity and providing for long term management can be seen to provide some minimization of the effect on species from habitat loss, it is the Service's opinion that a 50% rate of loss of suitable habitat is unsustainable for species, and does not result in adequate minimization.

The area of effect for vernal pool fairy shrimp is located at the southernmost 0.013-acre of the 0.613-acre wetland, does not exhibit the features characteristic of occupied vernal pools or swales within northern Alameda County, and will not result in changes to the overall function or hydrology of Seasonal Wetland 1. The area of effect for the San Joaquin kit fox consists of ruderal and non-native annual grassland habitat along I-580 primarily along the northern Caltrans right-of-way comprising relatively low quality kit fox habitat. Based on these reasons, it is the Service's opinion that the proposed compensation at 1:1 may minimize the effects of take of this project subject to clarification of where, how and when it will be implemented.

The affected areas for the California red-legged frog and California tiger salamander represent occupied breeding, upland, migratory and dispersal habitat that potentially supports all life history stages for these species. Arroyo Las Positas, Cayetano, Tassajara and Arroyo Seco creeks are of higher quality than other urban/rural streams within the action area and support all California red-legged frog life history stages year-round. Seasonal Wetland 1 and non-native annual grasslands within the action area are part of a larger network of breeding, upland and dispersal habitat that supports the highest abundance of California tiger salamanders throughout the Central Valley DPS. Based on these reasons, it is the Service's opinion that compensation at 3:1 is appropriate to minimize the effects of take.

INCIDENTAL TAKE STATEMENT

Section 9(a)(1) of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened fish and wildlife species without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with this Incidental Take Statement.

The measures described below are non-discretionary, and must be implemented by Caltrans so that they become binding conditions of any grant or permit issued to Caltrans, as appropriate, in order for the exemption in section 7(o)(2) to apply. Caltrans has a continuing duty to regulate the activity covered by this incidental take statement. If Caltrans (1) fails to require Caltrans to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, and/or (2) fails to retain oversight to ensure compliance with these terms and conditions, the protective coverage of section 7(o)(2) may lapse.

Amount or Extent of Take

Vernal Pool Fairy Shrimp

The Service anticipates that incidental take of the vernal pool fairy shrimp will be difficult to detect based on the small size and cryptic coloration of fairy shrimp cysts; thereby making it difficult to identify unviable, injured or dead specimens. Losses may also be masked by seasonal and annual fluctuations in abundance and density. The Service anticipates quantifying take of vernal pool fairy shrimp cysts to be difficult, since all work within Seasonal Wetland 1 will be conducted during the dry season between April 15 and October 15 when soils are dry and fairy shrimp persist only in the cyst stage, the Service anticipates take incidental to the proposed action as vernal pool fairy shrimp cysts inhabiting or utilizing the 0.013-acre of suitable habitat in Seasonal Wetland 1. Upon implementation of the following Reasonable and Prudent Measures, incidental take of all vernal pool fairy shrimp cysts within the 0.013-acre of Seasonal Wetland 1 will become exempt from the prohibitions described under section 9 of the Act resulting from the proposed action.

California Red-Legged Frog

The Service anticipates that incidental take of the California red-legged frog will be difficult to detect for the following reasons: their relatively small body size make the finding of a dead specimen unlikely; the cryptic nature of the species; losses may be masked by seasonal fluctuations in numbers or other causes; and the species occurs in aquatic, riparian and upland habitats that makes it difficult to detect. Due to the difficulty in quantifying the number of California red-legged frogs that will be taken as a result of the proposed action, the Service is quantifying take incidental to the proposed action as all California red-legged frogs inhabiting or utilizing the 20.09 acres of suitable habitat identified in the Biological Assessment. The Service anticipates that take of larval, juvenile and adult life history stages may be harmed, harassed, or killed resulting from habitat loss/degradation, construction-related disturbance, or capture and relocation. Upon implementation of the following Reasonable and Prudent Measures, all larvae, juvenile, subadult or adult California red-legged frogs within the action area will become exempt from the prohibitions described under section 9 of the Act resulting from the proposed action. No other forms of take are authorized under this opinion.

Central Valley DPS California Tiger Salamander

The Service anticipates that incidental take of the California tiger salamander will be difficult to detect because when this amphibian is not in their breeding ponds, foraging, migrating, or conducting other surface activity, it inhabits fossorial mammal burrows and other underground refugia; upland refugia may be located a distance from the breeding ponds; the migrations occur on a limited period during rainy nights in the fall, winter, or spring; and the finding of an injured or dead individual is unlikely because of its relatively small body size and cryptic nature. Losses of this species may also be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in the water regime at their breeding ponds, or additional environmental disturbances. Due to the difficulty in quantifying the number of California tiger salamanders that will be taken as a result of the proposed action, the Service is quantifying take incidental to the proposed action as all California tiger salamanders inhabiting or utilizing the 8.56 acres of suitable habitat identified in the Biological Assessment. The Service anticipates that take of juvenile or adult California tiger salamanders may be harmed, harassed, or killed resulting from habitat loss/degradation, construction-related disturbance, or capture and relocation. Upon implementation of the following Reasonable and Prudent Measures, all juvenile or adult California tiger salamanders within the action area will become exempt from the prohibitions described under section 9 of the Act resulting from the proposed action. No other forms of take are authorized under this opinion.

San Joaquin Kit Fox

The Service expects that incidental take of the San Joaquin kit fox may be difficult to detect, since kit fox are likely to seek refuge within dens if injured or harassed. Due to the difficulty in quantifying the number of San Joaquin kit fox that will be taken as a result of the proposed action, the Service is quantifying take incidental to the proposed action as San Joaquin kit fox inhabiting or utilizing the 21.21 acres of suitable habitat identified in the Biological Assessment. The Service anticipates that one (1) juvenile or adult San Joaquin kit fox may be harmed, harassed or killed resulting from habitat loss/degradation, construction-related disturbance, or capture and relocation. Upon implementation of the following Reasonable and Prudent Measures, incidental take of one (1) juvenile or adult San Joaquin kit fox within the action area will become exempt from the prohibitions described under section 9 of the Act resulting from the proposed action. No other forms of take are authorized under this opinion.

Effect of the Take

The Service has determined that this level of anticipated take is not likely to result in jeopardy to the vernal pool fairy shrimp, California red-legged frog, Central Valley DPS California tiger salamander and San Joaquin kit fox, and is not likely to jeopardize the continued existence of these species.

Reasonable and Prudent Measures

The following reasonable and prudent measures are necessary and appropriate to minimize the effect of the proposed action on the vernal pool fairy shrimp, California red-legged frog, Central Valley DPS California tiger salamander and San Joaquin kit fox:

1. Caltrans shall implement conservation measures in the project description of the July 2008 Biological Assessment, the March 7, 2009 letter to the Service, and this biological opinion to minimize take in the form of harm.

2. Caltrans shall ensure adverse effects to the vernal pool fairy shrimp and its critical habitat, California red-legged frog, California tiger salamander and San Joaquin kit fox will be minimized.

3. Caltrans shall ensure their compliance with this biological opinion.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, Caltrans shall ensure compliance with the following terms and conditions, which implement the reasonable and prudent measures described above.

1. The following Terms and Conditions implement Reasonable and Prudent Measure one (1):

    a. Caltrans shall include Special Provisions that include the Conservation Measures and the Terms and Conditions of this biological opinion in the solicitation for bid information for all contracts for the project that are issued by them to all contractors. In addition, Caltrans shall educate and inform contractors involved in the project as to the requirements of the biological opinion.

    b. To reduce the overall level of take of vernal pool fairy shrimp, California red-legged frog, California tiger salamander and San Joaquin kit fox, Caltrans shall compensate for the take of species resulting from the net loss of habitat and temporal loss between the time the effects are incurred and the time when the compensation habitat is fully functional. The Service encourages Caltrans to seek habitat that comprises high quality breeding, foraging, sheltering, migration and/or dispersal habitat, or provides a functional linkage between areas of occupied habitat that assists in the recovery of the species by facilitating the (re)colonization of suitable, unoccupied habitat from source populations. Caltrans shall compensate for these effects through one of the following options:

Species	Total Project Effects	Effects Compensated by Other Projects[2]	Ratio	Compensation Required
Vernal pool fairy shrimp	0.013 ac	n/a	1:1	0.013 ac
California red-legged frog	20.09 ac	1.13 ac	3:1	56.88 ac
California tiger salamander	8.56 ac	0.04 ac	3:1	25.56 ac
San Joaquin kit fox	21.21 ac	2.336 ac	1:1	18.874 ac

i. Prior to or by the start of construction, Caltrans shall purchase conservation bank credits at a Service/DFG-approved conservation bank whose service area encompasses the action area for each of the four species. Conservation credits shall be purchased and documentation provided to the Service/DFG comprising the Agreement for Sale of Conservation Credits, Bill of Sale, Payment Receipt and Updated Credit Ledger within 30 days prior to project ground-breaking.

ii. Caltrans shall contribute toward the acquisition of habitat approved by the Service/DFG. The habitat shall have a conservation easement or other appropriate entitlement, management plan, and endowment to manage the habitat in perpetuity; all of which shall be reviewed and approved by the Service/DFG, and completed within 12 months following project ground-breaking. Acquisition of land shall either be through easement or fee title. The conservation easement shall name the Service/DFG as third-party beneficiaries and shall be held by an entity qualified to hold conservation easements subject to Service/DFG approval. An endowment to manage the land and monitor the conservation easement shall be secured using an escrow account or other funding assurance acceptable to and approved by the Service/DFG. The endowment shall be held by a Service/DFG-approved entity in an amount agreed to by the Service/DFG. A management plan shall be developed prior to or concurrent to the acquisition of land and shall include, but is not limited to: a description of existing habitats and planned habitat creation, restoration and/or enhancement; monitoring criteria for vernal pool fairy shrimp, California red-legged frog, California tiger salamander and San Joaquin kit fox; an integrated pest management and monitoring plan to control invasive species; habitat creation, restoration and/or enhancement success criteria; and adaptive management strategies if success criteria are not met or to incorporate new scientific data. Compensation habitat shall meet the following criteria:

1. Vernal pool fairy shrimp habitat (0.013-acre) shall: (1) be located within Alameda County north of I-580; (2) exhibit the topography,

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[2] *Refers to the affected portion of federally listed species habitat that overlaps with other Caltrans projects for which* Section 7 consultation has been completed; the effects acreages have been subsequently removed from the total area calculations. These projects include I-580 Eastbound HOV (Service File #1-1-07-F-0273), I-580/Fallon Road Interchange (Service File # 1-1-07-F-0257), and I-580/Isabel Avenue Interchange (Service File # 1-1-07-F-0280).

inundation regime, food base, and physical parameters (*e.g.*, pH, salinity, *etc.*) to support all life history stages of the species; and (3) actively support the incubation, maturation, and reproductive life history stages of the species.

2. California red-legged frog habitat (56.88 acres) shall: (1) be located within Alameda County north of I-580 and east of Fallon Road; and (2) support breeding, provide upland habitat within 300 feet of a known breeding site, and/or function as dispersal/ migratory habitat.

3. California tiger salamander habitat (25.56 acres) shall: (1) be located within Alameda County north of I-580 and east of Fallon Road; and (2) support breeding, provide upland habitat within 2,200 feet of a known breeding site, and/or function as dispersal/ migratory habitat.

4. San Joaquin kit fox habitat (18.874 acres) shall: (1) be located within the kit fox recovery plan area in Alameda County north of I-580; (2) comprise a contiguous, undeveloped tract(s) of land that contributes toward the dispersal of the species into the northern range; (3) be located within grassland habitat that in part comprise slopes less than 22 percent with loose-textured, friable soils, and active ground squirrel activity; (4) provide a sufficient prey base to support to species; and (5) be free of rodenticide usage that could result in additional take of kit fox.

2. The following Terms and Conditions implement Reasonable and Prudent Measure two (2):

   a. The Resident Engineer or their designee shall be responsible for implementing the Conservation Measures and Terms and Conditions of this biological opinion and shall be the point of contact for the proposed action. The Resident Engineer or their designee shall maintain a copy of this biological opinion onsite whenever construction is in progress. Their name(s) and telephone number(s) shall be provided to the Service at least thirty (30) calendar days prior to ground-breaking at the project. Prior to ground-breaking, the Resident Engineer shall submit a letter to the Service verifying he/she is in possession of a copy of this biological opinion and has read and understands the Conservation Measures and Terms and Conditions.

   b. The Service-approved biologist(s) shall be onsite during all activities that may result in the take of the vernal pool fairy shrimp, California red-legged frog, California tiger salamander and San Joaquin kit fox. The qualifications of the biologist(s) shall be presented to the Service for review and written approval at least thirty (30) calendar days prior to ground-breaking at the project site. The Service-approved biologist(s) shall keep a copy of this biological opinion in their possession when onsite. The Service-approved biologist(s) shall be given the authority to communicate verbally or by telephone, email or hardcopy with Caltrans personnel, construction personnel or any other person(s) at the project site or otherwise associated with the project. The Service-approved biologist(s) shall have oversight over implementation of the Terms and Conditions in this biological opinion, and shall, in consultation with the Resident Engineer, have the authority to stop project activities if they determine any of the requirements associated with these Terms and Conditions are not being fulfilled. If the Service-approved biologist(s) exercises this authority, the Service shall be notified by telephone and email within 24 hours. The Service contact is Chris Nagano, Division Chief, Endangered Species Program, Sacramento Fish and Wildlife Office at telephone (916) 414-6600.

c. There shall be an adequate number of Service-approved biologists to monitor the effects of the project on the vernal pool fairy shrimp, California red-legged frog, California tiger salamander and San Joaquin kit fox. The number of Service-approved biologists who are on site shall be determined by the Service, CDFG, and/or the Caltrans biologist.

d. If California red-legged frogs or California tiger salamanders are encountered in the action area, work within the immediate vicinity should cease immediately and the Resident Engineer and Service-approved biologist shall be notified. Based on the professional judgment of the Service-approved biologist, if project activities can be conducted without harming or injuring the California red-legged frog(s) or California tiger salamander(s), the individual(s) shall be left at the location of discovery and monitored by the Service-approved biologist. All project personnel shall be notified of the finding and at no time shall work occur within the vicinity of the listed species without a biological monitor present. If it is determined by the Service-approved biologist that relocating the California red-legged frog(s) or California tiger salamander(s) is necessary, the following steps shall be followed:

   i. Prior to handling and relocation the Service-approved biologist shall take precautions to prevent introduction of amphibian diseases in accordance with the *Revised Guidance on Site Assessments and Field Surveys for the California Red-legged Frog* (Service 2005d) and *Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander* (Service 2003b). Disinfecting equipment and clothing is especially important when biologists are coming to the action area to handle amphibians after working in other aquatic habitats.

   ii. California red-legged frogs and California tiger salamanders shall be captured by hand, dipnet or other Service-approved methodology, transported by hand, dipnet or temporary holding container, and released as soon as practicable the same day of capture. Handling of California red-legged frogs and California tiger salamanders shall be minimized to the maximum extent practicable. Holding/transporting containers and dipnets shall be thoroughly cleaned and disinfected prior to transporting to the action area and shall be rinsed with freshwater onsite immediately prior to usage unless doing so would result in the injury or death of an individual frog or salamander due to the time delay.

iii. California red-legged frogs and California tiger salamanders shall be relocated to the nearest suitable habitat outside of the area where actions would result in harm or harassment and released on the same side of Interstate 580 where it was discovered. If salamanders are captured from burrows, they shall be relocated to the nearest active burrow network outside of the work zone. The release burrow(s) shall be actively occupied by ground squirrels, since inactive burrows can collapse if not maintained. No more than two juvenile or adult salamanders shall be released into the same burrow. Transporting California red-legged frogs and California tiger salamanders to a location other than the location described herein shall require written authorization of the Service.

e. The top 6 inches of topsoil shall be excavated from Seasonal Wetland 1 shall be set aside and replaced when the retaining wall installation is complete.

f. If a San Joaquin kit fox den is observed within the action area, the type (natal or non-natal) and status (occupied or unoccupied) shall be identified based on the *San Joaquin Kit Fox Survey Protocol for the Northern Range* (Service 1999):

i. Caltrans shall establish a buffer or exclusion zone to protect the occupied dens and surrounding habitat including nearby unoccupied dens that can be avoided:

1. A 200 foot buffer shall be established around unoccupied natal dens, and a 100 foot buffer shall be established around occupied dens or known unoccupied non-natal dens.

2. If occupied dens are found within the action area, ground disturbing activities shall be restricted, until kit fox have left the area voluntarily.

3. During this period, project activities within 0.3 miles of occupied natal dens are prohibited. Buffer zones shall be delineated with a temporary fence or other suitable barrier that does not hinder movement of the fox. Alternatively, the project construction area can be delineated with temporary fence, flagging, or other barrier.

ii. If a natural den cannot be avoided and must be destroyed, the following guidelines shall be followed:

1. Prior to the destruction of any den, the den shall be monitored by a qualified Service-approved biologist for at least three consecutive days to determine its current status. Activity at the den shall be monitored by camera traps, tracking medium and/or spotlighting surveys in accordance with Service protocol (Service 1999). If no kit fox activity is observed during this period, the den shall be destroyed immediately to preclude subsequent use. If kit fox activity is observed at the den during this period, the den shall be monitored for at least five consecutive days from the time of observation to allow any resident animal to move to another den

during its normal activities. Destruction of the den may begin when, in the judgment of a Service or Service-approved biologist, it is temporarily vacant, for example during the animal's normal foraging activities.

2. All dens shall be excavated by hand or light construction equipment under the supervision of a Service-approved biologist.

3. The den shall be fully excavated and then backfilled and compacted to ensure that kit foxes cannot re-enter or use the den during the construction period. If, at any point during excavation a kit fox is discovered inside the den, the excavation activity shall cease immediately and monitoring of the den shall be resumed. Destruction of the den may be resumed, when in the judgment of the Service-approved biologist, the animal has escaped from the partially destroyed den.

4. Non-natal dens may be excavated at any time of the year. Natal dens shall only be excavated between August 15 and November 1.

g. The Service-approved biologist shall maintain monitoring records that include: (1) the beginning and ending time of each day's monitoring effort; (2) a statement identifying the species, including general wildlife species, were encountered, including the time and location when such species were found; (3) the time the specimen was identified and by whom and its condition; and (4) a description of any actions taken. The biological monitor shall maintain complete records in their possession while conducting monitoring activities and shall immediately surrender records to the Service upon request. All monitoring records shall be provided to the Service upon completion of the monitoring work.

3. The following Terms and Conditions implement Reasonable and Prudent Measure three (3):

   a. If verbally requested, before, during, or upon completion of ground breaking and construction activities, Caltrans shall ensure the Service, CDFG, and/or their designated agents can immediately and without delay, access and inspect the project site for compliance with the proposed project description, conservation measures, and terms and conditions of this biological opinion, and to evaluate project effects to the vernal pool fairy shrimp, California red-legged frog, California tiger salamander, San Joaquin kit fox and their habitat.

   b. The following shall be implemented for all staging, storage, lay down, vehicle access, and parking areas associated with the project:

      i. Contractors may independently seek off-site staging locations. Offsite staging locations shall be subject to the requirements of resource agencies and permits will be the responsibility of the contractor.

ii. Caltrans shall require as part of the construction contract that all contractors comply with the Act in the performance of the work as described in the project description of this biological opinion.

c. The Service-approved biologist shall maintain written monitoring records that include: (1) the beginning and ending time of each day's monitoring effort; (2) a statement identifying the species, including general wildlife species, were encountered, including the time and location when such species were found; (3) the time the specimen was identified and by whom and its condition; and (4) a description of any actions taken. The biological monitor shall maintain complete records in their possession while conducting monitoring activities and shall immediately surrender records to the Service or CDFG upon verbal or written request. Originals of all monitoring records shall be provided to the Service immediately upon completion of the monitoring work.

Reporting Requirements

Proof of environmental training and fulfillment of compensation requirements shall be provided to the Chris Nagano, Division Chief, Endangered Species Program, Sacramento Fish and Wildlife Office, 2800 Cottage Way, Room W-2605, Sacramento, California 95825-1846. Observations of vernal pool fairy shrimp, California red-legged frog, California tiger salamander and San Joaquin kit fox, or any other listed or sensitive animal species should be reported to the California Natural Diversity Database (CNDDB) within thirty (30) calendar days of the observation.

Injured California red-legged frog, California tiger salamander and San Joaquin kit fox must be cared for by a licensed veterinarian or other qualified person, such as the on-site biologist. Dead individuals of any listed species shall be placed in a Zip-lock® bag containing a piece of paper with the date, time and location where the specimen was found, the name of the person who found it in permanent ink, and then placed in a freezer in a secure location. The Service and the California Department of Fish and Game must be notified within 24 hours of the discovery of death or injury resulting from project-related activities or is 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 Chris Nagano, Division Chief, Endangered Species Program, Sacramento Fish and Wildlife Office at Chris_Nagano@fws.gov and (916) 414-6600, and Dan Crum, Resident Agent-in-Charge Dan Crum of the Service's Law Enforcement Division at (916) 414-6660.

Caltrans shall submit a post-construction compliance report prepared by the on-site biologist to the Sacramento Fish and Wildlife Office within sixty (60) calendar days of the date of the completion of construction activity. This report shall detail: (i) dates that construction occurred; (ii) pertinent information concerning the success of the project in meeting compensation and other conservation measures; (iii) an explanation of failure to meet such measures, if any; (iv) known project effects on the western snowy plover, if any; (v) occurrences of incidental take of western snowy plovers, if any; (vi) documentation of employee environmental education; and (vii) other pertinent information. The report shall be addressed to the Chris Nagano, Division Chief, Endangered Species Program, Sacramento Fish and Wildlife Office, 2800 Cottage Way, Room W-2605, Sacramento, California 95825-1846.

Caltrans shall report to the Service any information about take or suspected take of listed wildlife species not authorized by this biological opinion. Caltrans must notify the Service via electronic mail and telephone within twenty-four (24) hours of receiving such information. Notification must include the date, time, location of the incident or of the finding of a dead or injured animal, and photographs of the specific animal. The individual animal shall be preserved, as appropriate, and held in a secure location until instructions are received from the Service regarding the disposition of the specimen or the Service takes custody of the specimen. The Service contacts are Chris Nagano, Division Chief, Endangered Species Program, Sacramento Fish and Wildlife Office at Chris_Nagano@fws.gov and (916) 414-6600, and Resident Agent-in-Charge Dan Crum of the Service's Law Enforcement Division at (916) 414-6660.

CONSERVATION RECOMMENDATIONS

Conservation recommendations are suggestions of the Service regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of new information. These measures may serve to further minimize or avoid the adverse effects of a proposed action on listed, proposed, or candidate species, or on designated critical habitat. They may also serve as suggestions on how action agencies can assist species conservation in furtherance of their responsibilities under section 7(a)(1) of the Act, or recommend studies improving an understanding of a species' biology or ecology. Wherever possible, conservation recommendations should be tied to tasks identified in recovery plans. The Service is providing you with the following conservation recommendations:

1. Caltrans should assist the Service in implementing recovery actions identified in the *Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon* (Service 2005a), *Recovery Plan for the California Red-legged Frog* (Service 2002), and *Recovery Plan for Upland Species of the San Joaquin Valley, California* (Service 1998).

2. Caltrans should consider participating in the planning for a regional habitat conservation plan for the vernal pool fairy shrimp, California red-legged frog, California tiger salamander, San Joaquin kit fox, and other listed and sensitive species in Alameda County.

3. Caltrans should consider establishing functioning preservation and creation conservation banking systems to further the conservation of the vernal pool fairy shrimp, California red-legged frog, California tiger salamander, San Joaquin kit fox, and other appropriate species. Such banking systems also could possibly be utilized for other required mitigation (i.e., seasonal wetlands, riparian habitats, etc.) where appropriate.

4. 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.

5. Caltrans should incorporate culverts, tunnels, or bridges on highways and other roadways that allow safe passage by California red-legged frog, California tiger salamander, San Joaquin kit fox, and other listed and common animals. Caltrans should include photographs, plans, and other information in their biological assessments if they incorporate "wildlife friendly" crossings into their projects.

6. Caltrans should provide roosting habitat for bats, when designing bridges, overpasses and other suitable structures whenever possible.

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

REINITIATION--CLOSING STATEMENT

This concludes formal consultation on the proposed Interstate 580 Westbound HOV Lane Project, Alameda County, California. As provided in 50 CFR §402.16 and in the terms and conditions of this biological opinion, 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 questions concerning this opinion on the proposed I-580 Westbound HOV Lane Project, Alameda County, California, Jerry Roe or Ryan Olah at the letterhead address or at (916) 414-6600.

Sincerely,

for Susan K. Moore
Field Supervisor

cc:
Ray Akkawi, Alameda County Congestion Management Agency, Oakland, CA
Melissa Escaron, California Department of Fish and Game, Oakland, CA
Liam Davis, California Department of Fish and Game, Yountville, CA
Scott Wilson, California Department of Fish and Game, Yountville, CA

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United States Department of the Interior

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In Reply Refer To:
81420-2008-F-0487-R001

SEP 15 2010

Mr. Jim Richards
Attn: Katie Thoreson
Office of Biological Sciences and Permits
California Department of Transportation
P.O. Box 23660
Oakland, California 94623-0660

Subject: Reinitiation of Consultation of the Biological Opinion on the Effects of the Interstate 580 Westbound HOV Lane Project, Alameda County, California (Caltrans EA 4S3701) for the Inclusion of a Secant Soldier Beam Wall near Arroyo Las Positas

Dear Mr. Richards:

This letter is a reinitiation of the Biological Opinion issued on September 17, 2009 (Service File No.: 81420-2008-F-0487-2) for the Interstate 580 (I-580) Westbound HOV Lane Project located in Alameda County, California. Reinitiation of consultation was requested by Caltrans to include the installation of a secant soldier beam wall within the project footprint near Arroyo Las Positas Creek to prevent further erosion from occurring along the southern streambank adjacent to westbound I-580. Reinitiation of consultation is exercised under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.) (Act).

The following changes are made to the September 17, 2009, biological opinion:

1. Add the following to the **Consultation History** on page 3:

November 6, 2010	The Service attended a site visit with Caltrans to evaluate the effects of the slide repair on listed species.
July 14, 2010	The Service received a letter from Caltrans dated July 14, 2010, requesting reinitiation of formal consultation to include installation of a secant soldier beam wall near Arroyo Las Positas within the I-580 Westbound HOV project footprint.

2. Add the following to the **Description of the Proposed Action** on page 3:

The proposed location of the secant soldier beam wall is north of I-580 at Post Mile 11.1 (PM) in the City of Livermore, Alameda County, California. Caltrans proposes to construct a secant soldier beam wall parallel to the stream bank to prevent further erosion of the Arroyo Las Positas stream bank from encroaching into the Caltrans Right-of-Way

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(ROW). The existing south bank of Arroyo Las Positas at PM 11.1 has been severely eroded by storm floodwaters causing large portions of the bank to calve off. The stream bank at this location is eroding at a rate of approximately 6 to 10 inches per year and is progressing towards the edge of roadway pavement on north side of westbound I-580.

The proposed wall will be constructed at least 12 feet from the edge of the southern bank of Arroyo Las Positas and will be installed entirely below ground. Vertical wall face area will be approximately 4,200 square feet. The soldier pile wall is estimated to extend approximately 17 feet upward from the bottom of the Arroyo channel and extend approximately 19 feet below the Arroyo Bed. The total wall height is estimated to be approximately 36 feet.

Construction

The proposed secant wall will consist of a single line of alternating drilled concrete piles, both reinforced and unreinforced. Alternating unreinforced piles will be constructed and allowed to set for a short period of time. Subsequently, reinforced concrete piles will be constructed between the previously constructed piles. The use of temporary casing will be needed to prevent caving of the drilled pile shafts. The wall will not have any facing attached once completed. This secant wall construction method will avoid any construction impacts to the stream channel. The top of the secant soldier pile wall will extend approximately 20 feet above stream channel. The wall will be covered with fill and revegetated upon completion.

Project Schedule

The proposed action is scheduled to occur in August 2011. Construction of the project will take approximately one to two months to complete.

Equipment Used

The equipment and vehicles used for the construction of the proposed secant soldier beam wall will include tracked drilling equipment, a truck mounted concrete mixing/pumping system and hauling trucks. The exact type and number of construction vehicles used to conduct the work will be at the discretion of the contractor.

Staging and Access

The proposed staging area is adjacent to I-580 within Caltrans ROW just west of the project site and is included entirely within the original project footprint. The area is highly disturbed consisting of highway shoulder and ruderal vegetation. No staging will be permitted in environmentally sensitive areas.

Construction Site Restoration

All temporarily disturbed areas will be restored to pre-project conditions. A Storm Water Pollution Control Plan will be applied during construction and erosion control measures will be applied following construction.

3. Change **Term and Condition 1.a.** on page 62 from:

   a. Caltrans shall include Special Provisions that include the Conservation Measures and the Terms and Conditions of this biological opinion in the solicitation for bid information for all contracts for the project that are issued by them to all contractors. In addition, Caltrans shall educate and inform contractors involved in the project as to the requirements of the biological opinion.

   To:

   a. Caltrans shall require all contractors to comply with the Act in the performance of the action and shall perform the action as outlined in the Project Description of this Biological Opinion as provided by Caltrans in the biological assessment dated July 2008, letter from Caltrans dated March 17, 2009 and July 14, 2010, and all other supporting documentation submitted to the Service in support of the action. Caltrans shall include language in their contracts that expressly requires contractors and subcontractors to work within the boundaries of project footprint identified in this Biological Opinion, including vehicle parking, staging, laydown areas, and access roads.

4. Change the **Reinitiation—Closing Statement** on page 70 from:

   This concludes formal consultation on the proposed Interstate 580 Westbound HOV Lane Project, Alameda County, California. As provided in 50 CFR §402.16 and in the terms and conditions of this biological opinion, 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.

   To:

   This concludes formal consultation on the proposed Interstate 580 Westbound HOV Lane Project, Alameda 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, including work outside of the project footprint analyzed in this opinion and including vehicle parking, staging, lay down areas, and access roads; (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 including use of vehicle parking, staging, lay down areas, and access roads; 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 re-initiation.

This concludes the reinitiation of formal consultation on the Interstate 580 Westbound HOV Lane Project, Alameda County, California. The remainder of the September 17, 2009 Biological Opinion is unchanged. If you have questions concerning this reinitiation of consultation on the Interstate 580 Westbound HOV Lane Project in Alameda County, California, please contact Jerry Roe or Ryan Olah at (916) 414-6600.

Sincerely,

Susan K. Moore
Field Supervisor

cc:
Amy Sparks, California Department of Transportation, Oakland, CA
Melissa Escaron, California Department of Fish and Game, Yountville, CA
Liam Davis, California Department of Fish and Game, Yountville, CA
Scott Wilson, California Department of Fish and Game, Yountville, CA

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. Gordon Danke
District Branch Chief, Branch 9
Office of Bridge Design West

Attn: Isaias Yalan

Date: June 22, 2010

File: 04-ALA-580 PM 11.1
EA: 04-4S3700
Arroyo Seco Creek
Tangent Soldier Pile Wall
Wall No. 33E0080

From: DAVID NESBITT
Transportation Engineer
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

MAHMOOD MOMENZADEH
Chief, Branch C
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Final Foundation Recommendations

This memo presents our foundation investigations, findings, and recommendation for the design and construction of the proposed tangent soldier pile wall at the above referenced location.

PROPOSED WALL

The proposed project site is located on the north side of Route 580 at Post mile 11.1 in the City of Livermore, Alameda County. The purpose of the proposed project is to construct a barrier that will prevent further erosion of the Caltrans Right-of-Way between Route 580 and the existing Arroyo Las Positas Creek. A tangent soldier pile wall has been proposed to achieve this purpose. According the General Plan sheet, the wall length is 95 feet and extends from Station 2+64.54 to 3+59.54, 38.5 feet right of Line 'LOL1". The wall will have a constant exposed wall height 21.5 ft, which includes the 4.5 ft of potential scour. The tangent soldier pile wall was selected after reviewing several design options. There are two factors limiting the design options: environmental restrictions involving entering the stream channel, and maintaining the clear recovery zone.

GEOLOGY AND SUBSURFACE CONDITIONS

Site Geology

The proposed project is located in the Livermore Valley. The geology of the Livermore Valley consist of Floodplain Deposits, Alluvial fan and Fluvial deposits, Alluvial Fan and Terrance deposits, and the Livermore gravels. These deposits consist of clay, silty clay, gravelly sands, and sandy gravels.

The table below lists the active faults near the project area and the peak ground accelerations that could be expected from a maximum credible earthquake from each of these faults for the tangent soldier pile wall.

FAULT	Distance from project (miles)	Maximum Credible Earthquake	Peak Ground Acceleration
Greenville	4.9 km (3.1)	7.25	0.50 g
Calaveras	11.6 km (7.2)	7.5	0.37 g
Hayward	29.0 km (12.4)	7.5	0.30 g

Subsurface Conditions

A single soil boring (R-09-101) was drilled adjacent to the proposed tangent soldier pile wall location on June 2, 2009 by Caltrans Drilling Services. The soil boring was drilled using the rotary wash method. Samples were collected using a spilt spoon sampler 2.0-inch OD (SPT). Caltrans also conducted a single Cone Penetration Test (CPT) adjacent to the proposed tangent soldier pile wall on June 9, 2009.

Soil boring R-09-101 was drill to a depth of 50.0 ft, or to an approximate elevation of 460.3 ft. The existing ground surface is at approximately 511.8 ft Elevation. The soil boring indicates the following sequences of the subsurface conditions:

Existing ground surface to a depth of 15 ft: A medium stiff - stiff clay layer,
15 ft to 25 ft: A dense gravelly sand layer,
25 ft to 30 ft: A stiff clay layer,
30 ft to 35 ft: A dense clayey sand layer,
35 ft to 45 ft: A very dense sandy gravel layer
45 ft to 50 ft: A very stiff clay layer.

Groundwater was encountered at an elevation of approximately 496 ft, which is 15.8 ft below the ground surface in boring R-09-101. The boring was left open overnight before the groundwater elevation was measured. The groundwater could be higher or lower than the measured level due to seasonal variation in precipitations.

SCOUR

The proposed tangent solider pile wall is recommended to prevent further lateral erosion of the stream bank. The existing channel bottom is at an approximate elevation of 494 ft, which gives a wall height of 17 feet. The revised scour estimate provided by Caltrans Structures Hydraulic group is a potential scour depth of 4.5 feet, which results in wall height of 21.5 feet. The revised scour depth was provided to us by Structures Design through email correspondence in June 2010.

CORROSIVITY

One corrosion sample was collected from boring R-09-101 during the field investigation. The test result is shown in Table 1 indicate the site is non-corrosive based on the current Caltrans guidelines.

Table 1 Corrosivity Test Result

Location	Depth (ft)	pH	Minimum Resistivity (ohm-cm)	Chloride Content (ppm)	Sulfate Content (ppm)
R-09-101	0-5	6.8	1989	-	-

Note: Caltrans currently considers a site to be corrosive to foundation elements if one or more of the following conditions exist: Chloride concentration is greater than or equal to 500 ppm, sulfate concentration is greater than or equal to 2000 ppm, or pH is 5.5 or less.

SEISMICITY/LIQUEFACTION POTENTIAL

The potential for liquefaction is low due the dense to very dense gravelly sand layers and the stiff to very stiff clay layers.

GEOTECHNICAL RECOMMENDATIONS

The following recommendation is based on the subsurface soil conditions, groundwater elevations, and topography for the proposed tangent soldier pile wall location.

Geotechnical Design Parameter for Tangent Soldier Pile wall

We are recommending that a tangent soldier pile wall be constructed 12 feet from the edge of the stream bank, and parallel to SR 580.

Please refer to Figure 5.5.5.6-3 of the Bridge Design Specifications dated August 2004 for the earth pressure distributions along the wall. The base of the wall is 4.5 ft below the creek bed level, which is approximately 21.5 ft below the existing ground surface above the creek adjacent to Route 580. If the wall height exceeds the limit for a tangent pile wall without tieback, we recommend using a sloping backfill of 1V:2H to reduce the wall height.

We recommend using an effective friction angle (ϕ'_f) = 32 degrees, a Unit weight (γ) =120 lb/ft^3, a backfill slope (β)= 0.0 which will give a coefficient of active lateral earth pressure (k_a) = 0.30 for the backfill soil material above the base of the wall. No passive pressure shall be assumed for the existing soil in front and above the base of the wall since they will be subject to erosion over the long term. Add hydrostatic pressure from 15 ft depth below the top of the wall.

For the active and passive earth pressure below the base of wall, use undrained shear strength of Su=2000 psf and a Unit weight (γ) =120 lb/ft^3.

Use a uniform seismic earth pressure increment equal to 18 pcf. The resulting seismic force increment shall be applied at 0.5H above the base of wall where H is the wall height.

CONSTRUCTION CONSIDERATIONS

We recommend that a Geotechnical Engineer, from the Office of Geotechnical Design – West, Branch C, be on site to inspect the drilled holes and the placement of concrete during the construction of the tangent soldier pile wall.

The use of temporary casing will likely be required during construction of the tangent soldier piles due to the sand and gravel layers, and groundwater elevation. Dewatering may not be practical due to proximity of the piles to streambed. The contractor will need to tremie the concrete using the wet method.

* * * * *

If you have any questions or need additional information, please call David Nesbitt at 510-622-0104, or Mahmood Momenzadeh at 510-286-5732.

c: TPokrywka, MMomenzadeh, Structures RE Pending, KHolden, MWillian, EAraim, RMusni, Daily File, Route File

DNesbitt/

State of California
Department of Transportation
Division of Engineering Services
Office of Design and Technical Services

Structures Hydraulics and Hydrology

Structures
Final Hydraulic Report

SECANT SOLDIER PILE WALL

Located on Route 580 in Alameda County

JOB:

Arroyo Seco Creek
Secant Soldier Pile Wall
Wall No. 33E0080
EA – 04-4S3700

LOCATION:

04-ALA-580-PM 11.1

DATE:

June 15, 2010

REGISTERED CIVIL ENGINEER (SIGNATURE):

REGISTERED PROFESSIONAL ENGINEER
RICK R. MACALA
C 67475
EXP. 6/30/11
CIVIL
STATE OF CALIFORNIA

RICK R. MACALA, PE
Registration Number C67475

This report has been prepared under my direct supervision as the professional engineer in responsible charge of the work, in accordance with the provisions of the Professional Engineers Act of the State of California.

Arroyo Seco Creek
Secant Soldier Pile Wall
Wall No. 33E0080
04-ALA-580-PM 11.1
EA: 04-4S3700

Hydrology/Hydraulic Report

GENERAL:

This final hydraulic report (FHR) supersedes the FHR dated May 28, 2010 for the secant soldier pile wall (Wall No. 33E0080) along Arroyo Seco Creek.

Downstream of Arroyo Seco Creek Bridge (Bridge Number 33-0066) the existing channel of Arroyo Seco Creek is experiencing stream instability issues, where the creek is meandering and causing lateral erosion of the channel side slopes. Most notably the southern bank (north of Interstate 580) has severe erosion of the side slope and has encroached into the Caltrans right-of-way between the creek and the westbound lane of Interstate 580.

Therefore it has been proposed by Geotechnical Design to construct a secant soldier pile wall, aligned parallel to the freeway, to prevent the further lateral erosion of Arroyo Seco's channel slopes and encroachment into Interstate 580. Structure Hydraulics Branch evaluated how the secant soldier pile wall will affect local hydraulic conditions at Arroyo Seco Creek in the vicinity of the project site.

Arroyo Seco Creek Bridge is a three barrel concrete box culvert (12 feet by 10 feet cells) with concrete aprons entering and exiting the bridge.

The data and references of this hydraulic report are obtained from the following sources:

- Caltrans' Bridge Maintenance Records.
- "Draft Foundation Recommendations for Secant Soldier Pile Wall" from Geotechnical Services, Office of Geotechnical Design-West, dated September 8, 2009.
- 1954 original As-Built General Plan, Details, and Log of Test Borings for Arroyo Seco Creek Bridge (Br. No. 33-0066).
- 1970 As-Built Drainage Details (pg. 63 of 248) and Miscellaneous Drainage Details (pg. 89 of 248) for the widening project of Interstate 580.
- "Draft Proposed New Wall Layout Line Plan" for the Secant Soldier Pile Wall from the Office of Bridge Design, Branch 09, dated May 2010.
- Field topographical survey data from District 04 Surveys completed on May 1, 2009.
- Field reconnaissance and photo documentation dated January 19, 2009 and May 4, 2010.

Note: unless otherwise stated, all vertical elevations in this report are based from the North American Vertical Datum of 1988 (NAVD88).

DESIGN OBJECTIVES:

Due to the channel instability and erosion of the channel slopes, this Final Hydraulics Report addresses the proposed mitigation of adding a secant soldier pile wall and the introduced scour and hydraulic issues of this design proposal. In addition, due to the close proximity of the design project downstream of Arroyo Seco Creek Bridge, any introduced hydraulic issues to this bridge were investigated.

To achieve these objectives, a hydraulic model was developed using the one-dimensional river analysis software HEC-RAS (v. 4.0). Two specific plans were modeled to cover all the aspects of the design and anticipated conditions:

1. Existing Conditions Plan, and
2. Proposed Secant Soldier Pile Wall (with long term scour effects) Plan.

Plan 2 is based on the assumption that the lateral erosion of the channel side slope will continue until it reaches the secant soldier pile wall. At this point the channel flows will be flowing parallel against a concrete wall thus increasing local velocity gradients resulting from the reduced roughness of the wall and introducing local scour.

BASIN:

Arroyo Seco Creek drains a watershed of approximately 24.7 square miles above the bridge site at Interstate 580. Arroyo Seco Creek is a tributary to Arroyo Las Positas Creek, just downstream from the project site. The watershed drains the southwestern hills of the Livermore Valley. The area is bounded on the northeast by the alluvial plain of the San Joaquin Valley and on the southwest by the coast part of the Coastal Ranges.

The land use of the watershed consists of dense suburban sprawl in the lower reaches to irrigated farmland, grassland and sparse forest in the upper watershed reaches. From its headwaters in the Livermore Hills at an elevation of approximately 2,800 feet, Arroyo Seco Creek flows in a north westerly direction through rolling hills until it reaches the Livermore Valley at an elevation of 500 feet near the project site and enters Arroyo Las Positas Creek just downstream of the Arroyo Seco Creek Bridge. The watershed boundary is located on USGS Quadrangle Maps for Cedar Mountain, Mendenhall Springs, Midway and Altamont.

The climate of the Livermore Valley consists of a semiarid climate with cool winters and hot summers. The area is inland from the coast far enough that the climate is modified only slightly by marine influence. Average annual precipitation is approximately 15.0 inches. Temperatures for the area range between 36.6° F to 89.0° F with a mean annual temperature of about 60° F.

DISCHARGE:

Flood discharges for Arroyo Seco Creek in the vicinity of the secant soldier pile wall were estimated for the 50-year and 100-year flood frequencies. Table 1 provides the design discharges for this project. These discharges are based on a basin-to-basin transfer method with Arroyo Mocho Creek. Arroyo Mocho Creek runs parallel with Arroyo Seco Creek, originates from the same headwaters, and shares many of the same hydrological parameters. In addition, Arroyo Mocho Creek was studied by detailed methods by the Federal Emergency Management Agency (FEMA) in the latest FEMA Flood Insurance Study (FIS) for Alameda County[1]. Therefore, the basin-to basin transfer method between Arroyo Mocho Creek and Arroyo Seco Creek was considered a very accurate approximation.

Table 1: Design Discharges.

Return Period	Peak Discharge (cfs)
50-Year	2,260
100-Year	2,780

STAGE, VELOCITY, AND FREEBOARD:

The 50-year and 100-year discharges were modeled through the Arroyo Seco Creek Bridge using the existing conditions of the channel. Several river cross sections were used to model the erosion of the side slopes on the left bank; however, only the first cross section (Station 02+64.00) entering the erosion site will be used for analysis. Table 2 summarizes the hydraulic parameters upstream and downstream of the bridge and in the vicinity of the erosion site. This analysis provides a base comparison to the other design plan. Using the soffit elevation on the upstream and downstream faces of the bridge and the calculated water surface elevations, the available freeboard was calculated.

Table 2: Hydraulic Parameters for Arroyo Seco Creek Existing Conditions.

Return Period	Discharge (cfs)	Water Surface Elevation (ft)	Average Velocity (fps)	Freeboard (ft)
Upstream face of Br. No. 33-0066(at Station 08+37.28)				
50 -Year	2,260	506.9	9.7	3.6
100-Year	2,780	508.1	10.2	2.4
Downstream face of Br. No. 33-0066 (at Station 04+32.78)				
50 -Year	2,260	507.1	7.3	1.4
100-Year	2,780	508.1	8.0	0.4
Station 02+64.00 (cross section where erosion site begins)				
50 -Year	2,260	506.9	3.1	N/A
100-Year	2,780	508.1	3.3	N/A

Table 3 summarizes the hydraulic parameters after the secant soldier pile wall is installed with long term effects of erosion on the side slopes of the left bank. The long term effects of erosion

[1] 2009 FEMA Flood Insurance Study for Alameda County, California and Incorporated Areas (Community Number 060008), Volumes 1-3. August 3, 2009.

assumes that the left bank will continue to erode towards the westbound lane of Interstate 580 until it reaches the secant soldier pile wall. The hydraulic parameters at the bridge remain the same; however, average stream velocities near the erosion site have decreased. This is due to the fact that long term erosion will cause an increase in channel capacity at the erosion site thus lowering average stream velocities.

While average stream velocities near the site have decreased, local velocities at the secant soldier pile wall interface have increased. When the erosion reaches the secant soldier pile wall an increase in velocity gradients will result from the reduced roughness of the pile wall as compared to the natural channel. The hydraulic model confirms this assumption. Local velocities at the erosion site during existing conditions were approximately 0.7 feet per second (fps) and after long term erosion reaching the pile wall local velocities increased to approximately 2.9 fps.

This increase in local velocity at the pile wall interface will be used in the design of local scour effects caused by the flow running parallel to a vertical wall.

Table 3: Hydraulic Parameters for Arroyo Seco Creek with Pile Wall Added and Long Term Erosion.

Return Period	Discharge (cfs)	Water Surface Elevation (ft)	Average Velocity (fps)	Freeboard (ft)
Upstream face of Br. No. 33-0066(at Station 08+37.28)				
50 -Year	2,260	506.9	9.7	3.6
100-Year	2,780	508.1	10.2	2.4
Downstream face of Br. No. 33-0066 (at Station 04+32.78)				
50 -Year	2,260	507.1	7.3	1.4
100-Year	2,780	508.1	8.0	0.4
Station 02+64.00 (cross section where erosion site begins)				
50 -Year	2,260	506.9	2.3	N/A
100-Year	2,780	508.1	2.5	N/A

The proposed secant soldier pile wall design with long-term erosion does not alter the hydraulic conditions at the Arroyo Seco Creek Bridge nor does it cause any major issues to the existing channel. Therefore, the proposed secant soldier pile wall design proposal will not cause any significant impacts.

STREAMBED AND CHANNEL SLOPES:

Subsurface conditions near the erosion site are based on a soil boring performed by the Office of Geotechnical Design in June 2009. The soil boring was drilled adjacent to the alignment of the soldier pile wall. Below the existing ground surface is approximately 15 feet of a medium stiff to stiff clay layer. Below this layer are several layers including medium dense to dense gravelly sand, stiff clay, and dense sandy gravel layer. This material is known to be highly scourable and nothing should prevent scour from reaching the predicted depths.

Field observations find the channel bed composed of loose gravelly sand. The channel bed was also chocked with dense vegetation including grasses and small willow trees. The channel slopes were highly eroded near the two channel meander bends. The channel slopes that were not eroded appeared stable with vegetation growth of grasses and small trees.

DRIFT:

Bridge Maintenance Records indicate that over the years there has been a small amount of sand and gravel deposits within the culvert barrels. In addition, vegetation has grown from these silt deposits. However, bridge maintenance records do not indicate any significant history of drift issues at the bridge site.

Large storm events would blow out any accumulation of debris or silt deposits within the culvert.

SCOUR AND CHANNEL DEGRADATION:

The lateral erosion of the left bank at the erosion site is assumed to continue until it reaches the interface of the secant soldier pile wall. At this point, local velocities have been determined to increase from the reduced roughness of the secant soldier pile wall as compared to the natural channel. These increased local velocities will cause a local scour effect near the secant soldier pile wall. Using the increased local velocity at the secant soldier pile wall and a local maximum scour equation developed by the Federal Highway Administration (Hydraulic Engineering Circular No. 23, 3rd Ed), an estimate of the scour depth near the pile wall can be calculated. Table 4 summarizes the potential local scour depths at the erosion site.

Channel degradation was not included into the total scour analysis. From field reconnaissance and topographical survey data it was concluded that the channel appears to be vertically stable. However, there is a local scour hole of approximately 4.5 feet at the end of the Arroyo Seco Creek Bridge's concrete apron. The scour hole is caused by energy dissipation from the increased velocities leaving the concrete box culvert. This scour hole is only a local effect and not the cause of any long term channel degradation.

Table 4: Total Local Scour due to Flows Running Parallel to the Soldier Pile Wall.

Return Period	Existing Average Channel Bed Elevation (ft)	Local Scour Depth (ft)	Degradation[1] (ft)	Total Scour Elevation (ft)
50-Year	497.4	6.9	--	490.5
100-Year	497.4	7.8	--	489.6

Note:
1- Total scour analysis at the soldier pile wall did not include channel degradation. The channel appears to be vertically stable.

REQUIRED WATERWAY:

Through hydraulic modeling Arroyo Seco Creek Bridge was not impacted by the secant soldier pile wall project. Arroyo Seco Creek Bridge was able to pass the 100-year flood event without soffit impact. The proposed secant soldier pile wall design will have no significant impacts to the existing waterway at the bridge or at the erosion site.

CONCLUSIONS / RECOMMENDATIONS:

- A secant soldier pile wall was analyzed and designed to run parallel to the Interstate 580 westbound lane to impede the progress of bank erosion from Arroyo Seco Creek. The design was determined not to cause bank overtopping from a 100-year flood event or any other significant hydraulic issues.
- The secant soldier pile wall design did not cause any hydraulic issues to the Arroyo Seco Creek Bridge (Br. No. 33-0066).
- Predicted local scour elevations at the secant soldier pile wall were calculated to be 490.5 feet and 489.6 feet for the 50-year and 100-year flow events, respectively.
- Structure Hydraulics recommends designing the linear length of the secant soldier pile wall at least 96 feet to cover the historic and current length of the meander stretch. From the proposed pile wall layout line ("WCL1"), move the beginning of the wall alignment (Sta. 0+0.00) 10 feet down-station then continue up-station to terminate end of wall at Station 0+96.00.

Summary Information for the Bridge Designer

All vertical elevations on this sheet are based on the NAVD 1988 vertical datum.

Minimum Soffit Elevation	N/A
Anticipated Total Scour Elevation at Soldier Pile Wall (50-Yr Event / 100-Yr Event)	490.5 feet / 489.6 feet
Average Velocity (for 100-Yr Event)	2.5 fps

HYDROLOGIC SUMMARY

Drainage Area: 24.7 square miles

	Design Flood	Base Flood	Overtopping Flood
Frequency	50-Year	100-Year	>> 500-yr
Discharge	2,260 cfs	2,780 cfs	-
Water Surface Elevation at Soldier Pile Wall	506.9 ft	508.1 ft	-

Flood plain data are based upon information available when the plans were prepared and are shown to meet federal requirements. The accuracy of said information is not warranted by the State and interested or affected parties should make their own investigation.

This report has been prepared under my direction as the professional engineer in responsible charge of the work, in accordance with the provisions of the Professional Engineers Act of the State of California.

REGISTERED PROFESSIONAL ENGINEER
RICK R. MACALA
C 67475
EXP. 6/30/11
CIVIL
STATE OF CALIFORNIA

REGISTERED CIVIL ENGINEER (SIGNATURE)

REGISTRATION NUMBER: C67475 DATE: June 15, 2010

NON-STORM WATER INFORMATION PACKAGE

CONTRACT NO. 04-4S3704

04-ALA-580-PM 11.1

Install Tangent Soldier Pile Wall

California Department of Transportation
District 4
Water Quality Program
111 Grand Avenue
Oakland, California 94612

TABLE OF CONTENTS

CONTRACT NO. 04-4S3704

1. **Project Description**

   The proposed project will install a tangent soldier pile wall along the north side of Route 580 PM 11.1 in Alameda County, adjacent the Arroyo Seco Creek. The tangent soldier pile wall will be constructed parallel to Route 580 and approximately 28.5 feet north of the edge of pavement to prevent road failure from future slide and erosion.

2. **Construction Activities requiring Dewatering**

   The tangent soldier pile wall will be 95 linear feet long and drilled approximately 42.5 feet vertically into the ground with holes of 2.5 feet diameter. It is anticipated that ground water would be encountered.

   The dewatering locations are depicted on the Dewatering Location Plan in Attachment B.

3. **BMP for Groundwater Treatment**

   The treatment system must be capable of removing sediment and turbidity-producing suspended solids. Primary and secondary treatment may be required, or the design of the treatment system may require combined use of the various treatment components in series to achieve effective treatment. Treatment system must have components to remove sediment and turbidity-producing suspended solids such as:

   1. Desilting basins
   2. Settling tanks
   3. Sediment traps
   4. Gravity bag filters
   5. Sand media filters
   6. Pressurized bag filters
   7. Cartridge filters
   8. Chemical coagulants including in-line flocculants
   9. Temporary holding tanks
   10. Any combination of these systems to provide primary and secondary treatment

4. **Monitoring, Disposal, and Reuse of Treated Groundwater**

   Use a flow meter to measure all discharges from dewatering operations.

   Provide a method for discharging treated water and include a discharge location. Do not discharge treated water in a way that impacts natural bedding or aquatic life.

   Comply with the manufacturer's instructions for all calibrations of the flow meter. Perform calibrations in the presence of the Engineer.

   While the active treatment system is operated, perform:

   1. Flow rate monitoring to:
      1.1. Record daily discharge volumes
      1.2. Compute average daily volumes

2. Receiving water limitations monitoring. In the receiving storm water drainage system, the discharge must not cause:
   2.1. Downstream turbidity to increase to more than 50 Nephelometric Turbidity Units (NTU) if the natural background turbidity is less than 50 NTU
   2.2. Downstream turbidity to increase more than 10 percent above the natural background turbidity if the natural background turbidity is 50 NTU or greater
   2.3. Normal ambient temperature to be altered more than 5 degrees F
   2.4. Normal ambient pH to fall below 6.5, exceed 8.5, or change more than 0.5 units
   2.5. Dissolved oxygen concentration to fall below 5.0 mg/L

3. Discharge effluent limitations monitoring. The water to be discharged (effluent) must comply with the following:
   3.1. Discharged water turbidity must not be greater than 50 Nephelometric Turbidity Units (NTU)
   3.2. pH of the discharged water must be from 6.5 to 8.5
   3.3. Discharged water must not contain chlorine in excess of 0.02 mg/L (instantaneous maximum)

Inspect temporary active treatment system:
1. Daily if dewatering work occurs daily
2. Weekly if dewatering work does not occur daily

If observations and measurements confirm the water quality limits are exceeded:
1. Submit a Notice of Discharge Report as shown in the Preparation Manual within 3 business days of exceeding the limits
2. Document the reasons and corrective work performed to prevent a reoccurrence in the Notice of Discharge

Maintain the various components to prevent leaks and provide proper function. If a component of the dewatering equipment is not functioning properly, discontinue the dewatering operation and repair or replace the component.

Sediments removed from uncontaminated areas during maintenance of the treatment system must be dried, distributed uniformly, and stabilized at a location within the project limits approved by the Engineer.

Backfill and repair ground disturbance, including holes and depressions, caused by the installation and removal of the temporary active treatment system. Comply with Section 15-1.02, "Preservation of Property," of the Standard Specifications.

ATTACHMENT A

ESTIMATED GROUNDWATER SEEPAGE RATES IN THE PROJECT AREA

State of California
DEPARTMENT OF TRANSPORTATION

Business, Transportation and Housing Agency

Memorandum

Flex your power!
Be energy efficient!

To: MR. MAHMOOD MOMENZADEH
Chief, Branch C
Office of Geotechnical Design – West

Attention: D. Nesbitt
R. Musni

Date: May 6, 2011

File: 04-ALA-580 PM 11.1
04-4S370
Arroyo Seco Tangent Pile Wall

From: RIFAAT NASHED RN
Engineering Geologist
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

GRANT WILCOX GW
Chief, Branch B
Office of Geotechnical Design – West
Geotechnical Services
Division of Engineering Services

Subject: Seepage Rate (Flow Rate) Estimate at the CIDH Piles Area

This memo is in response to your request to provide the approximate groundwater seepage rate in the steel soldier pile holes at the suggested pile wall. It is our understanding that this information will be used in estimating dewatering quantities.

Based on the LOTB, one boring (R-09-101) was drilled in June 2009 at the project site, the soils encountered are 5.0 ft of clayey sand (SC), 5.0 ft well graded sand (SW), 5.0 ft fat clay (CH), 5.0 ft Clayey sand (SC), and 10.0 ft of poorly graded gravel (GP). Underground water was recorded at elevation 496.0 ft.

According to "The Federal Highway Report NO. FHWA-TS-80-224, Page 48-49" the Coefficient of Permeability K (ft./day) for the soils encountered are as follows:

Unified Soil Classification	Coefficient of Permeability K (ft./day)
clayey sand (Sc)	$2.7x10^{-5}$ to 0.14
Well graded sand (SW)	1.4 to 137
Fat clay (CH)	$2.7x10^{-7}$ x $2.7x10^{-5}$
Poorly graded gravel (GP)	13.7x27,400

Our estimate of the seepage rate (flow rate) for the project area is approximately 10.0 Gallons /day/ $ft^{2.}$ This seepage rate (flow rate) estimate is provided for cost estimate purpose only.

If you have any questions or need additional information, please call Rifaat Nashed at (510) 622-1773 or Grant Wilcox at (510) 286-4835.

c: TPokrywka, GWilcox, Route File, Daily File

RNashed/mm

ATTACHMENT B

DEWATERING LOCATION PLAN

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	580	11.1		

INDEX OF PLANS

STATE OF CALIFORNIA

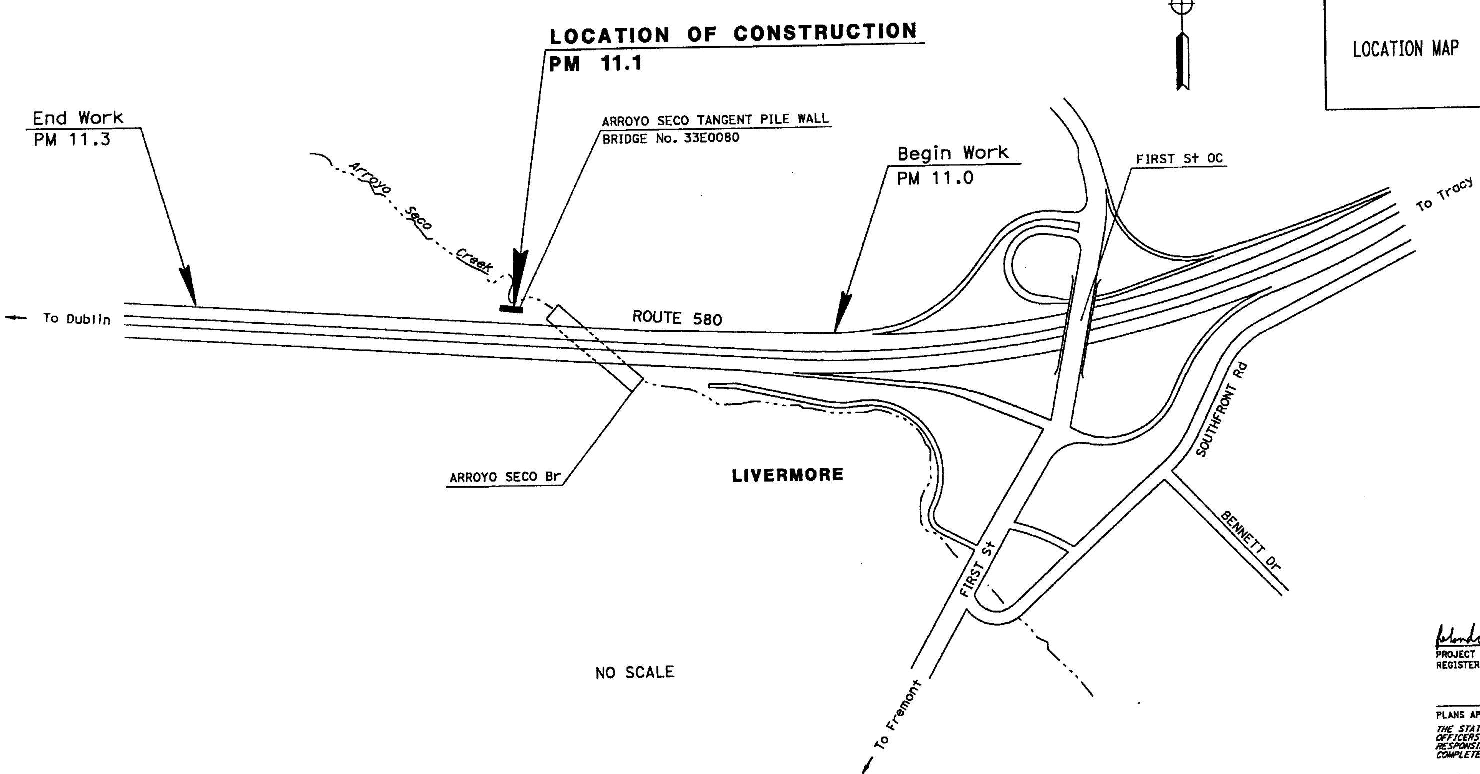
DEPARTMENT OF TRANSPORTATION

PROJECT PLANS FOR CONSTRUCTION ON

STATE HIGHWAY

IN ALAMEDA COUNTY IN LIVERMORE ABOUT 0.4 MILE WEST OF ROUTE 580 AND FIRST STREET OVERCROSSING

TO BE SUPPLEMENTED BY STANDARD PLANS DATED MAY 2006



PROJECT ENGINEER 3-21-11
REGISTERED CIVIL ENGINEER DATE

REGISTERED PROFESSIONAL ENGINEER R B MUSNI No. 69323 Exp. 6-30-12 CIVIL STATE OF CALIFORNIA

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

CONTRACT No.	04-4S3704
PROJECT ID	0400001230

DATE PLOTTED => 28-APR-2011
TIME PLOTTED => 12:51
LAST REVISION 04-05-11

PROJECT MANAGER JAY HAGHPARAST

DESIGN ENGINEER EMAD ARAIM

THE CONTRACTOR SHALL POSSESS THE CLASS (OR CLASSES) OF LICENSE AS SPECIFIED IN THE "NOTICE TO BIDDERS."

Dist	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET No.	TOTAL SHEETS
04	Ala	580	11.1		

REGISTERED CIVIL ENGINEER 3-21-11 DATE

PLANS APPROVAL DATE

THE STATE OF CALIFORNIA OR ITS OFFICERS OR AGENTS SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OR COMPLETENESS OF SCANNED COPIES OF THIS PLAN SHEET.

REGISTERED PROFESSIONAL ENGINEER R B MUSNI No. 69323 Exp. 6-30-12 CIVIL STATE OF CALIFORNIA

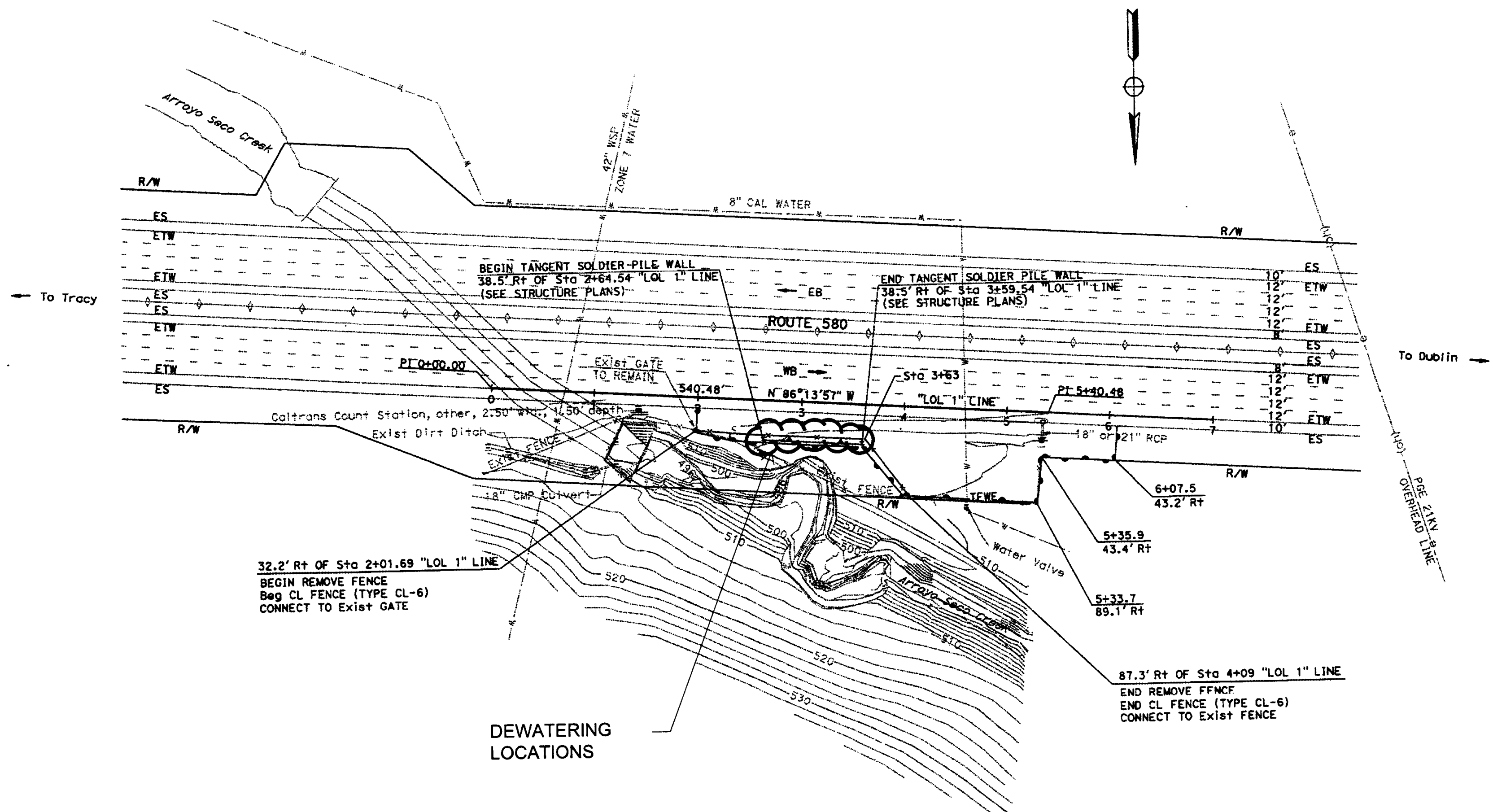
NOTE:

FOR ACCURATE RIGHT OF WAY DATA, CONTACT RIGHT OF WAY ENGINEERING AT THE DISTRICT OFFICE.

LEGEND:

TANGENT SOLDIER PILE WALL

TFWE - TEMPORARY FENCE (WILDLIFE EXCLUSION)



LAYOUT

L-1

SCALE: 1"=50'

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION	FUNCTIONAL SUPERVISOR	CALCULATED-DESIGNED BY	REVISED BY
Caltrans 06-DESIGN	EMAD ARAIM	GEORGE PANOS	
	CHECKED BY	ROLANDO MUSNI	DATE REVISED

LAST REVISION 03-15-11 | DATE PLOTTED => 28-APR-2011 | TIME PLOTTED => 12:50

BORDER LAST REVISED 7/2/2010

USERNAME => s127769
DGN FILE => -8896665.dgn

RELATIVE BORDER SCALE IS IN INCHES 0 1 2 3

UNIT 1473

PROJECT NUMBER & PHASE 0400001230

ATTACHMENT C

LOCAL PUBLICLY OWNED TREATMENT WORKS (POTW) FACILITY INFORMATION

Alameda POTW

	City Discharger	Treatment Plant Name	WDR Discharger Name	Discharger Contact Name	Contact Phone No.	Contact Email	Mail Address	Ct Contact for Groundwater & De-Watering Discharges	Service Area of the POTW
6	Dublin	Dublin San Ramon Service District	Dublin San Ramon SD	Bob Anderson/ Levi Fuller	925-875-2360, cell 925-570-8757; 925-846-0568, ext. 119	anderson@dsrsd.com; fuller@dsrsd.com	DSRSD, 7051 Dublin Blvd., Dublin, CA 94568	Call Env. Compliance Officer Eric Kuefner @ 925-875-2335 "case-by-case situation -prefer not during storms" Testing required,$385 for annual permit, per million gal fee, etc.	Dublin, San Ramon, & Pleasanton
7	Pleasanton		City of Pleasanton	Richard Lagomarsino; Daniel Smith	925-931-5538; 925-931-5509	rlagomarsino@ci.pleasanton.ca.us; dsmith@ci.pleasanton.ca.us	Richard Lagomarsino, Lead Utility Operator and Daniel Smith, Utility Superintendent, 3333 Busch Road, Pleasanton, CA 94588	Same as Dublin-San Ramon SD - see line #A- 7	Same as Dublin-San Ramon SD - see line #A- 7
8	Union City	Union SD	Union SD	Roger Ham	510-477-7540	roger_ham@unionsanitary.com	Roger Ham, Collection Service Manager, Union Sanitary District, 5072 Benson Road, Union City, CA 94587	Best contact is Von Henry @ 510-477-7637. UCSD would consider if there are no other options available, ie. If non-contaminated using the storm drain is "ok"	Services: Fremont (including Niles), Union City, & Newark
9	Livermore	City of Livermore WPCP	City of Livermore	Darren Greenwood	925-960-8100	dggreenwood@ci.livermore.ca.us	Darren Greenwood, Water Resources Manager, 101 West Jacklondon Blv., Livermore, CA 94551	Call Env. Source Control's - Alex Paredes 925-960-8144 : "requires testing, then annual G.W discharge Permit of $250, and $6,750 PMG's of discharge" - Will mail packet	City of Livermore, the Ruby Hills Development of Pleasanton, and the Veteran's Hospital of unincorporated Alameda County.
10	Hayward	City of Hayward WPCP	City of Hayward	Alex Ameri	510-583-4720	alexa@ci.hayward.ca.us	Alex Ameri, Deputy Director/Utilities, Dept. of Public Works, 777 B Street, Hayward, CA 94541-5007	Call Ms. Dije Ndreu @ 510-881-7960 They will accept discharge with test results. Permit fee is $470 plus per gallon fee. See email of 6/22/04 has all info	Per Alex Ameri: 90% of the city of Hayward is served by this sewer system - the other 10% (the North end, north of "A" St.) is serviced by Ora Loma Sanitation
11	San Leandro	San Leandro WPCP	City of San Leandro	Dean Wilson	510-577-6030	dwilson@ci.san-leandro.ca.us	Dean Wilson, Water Pollution Control Plant Manager, 3000 David St., San Leandro, CA 94577	Contact: John Camp in Env.Services @ 510-577-6029. "Haven't accepted in the past…prefers Baker tanks for sediment, then discharge to storm drain" There is a special Discharge Permit, includes $2.40 per 100 cu.ft. Would consider proposals.	Plant phone # is 510-577-3434 - they only do "the city boundaries of San Leandro - not the unincorporated areas - its sort of a Zig-Zag kind of thing..." They do have their boundaries on GIS - call Mike Hamer at 577-3339
12	San Lorenzo	Oro Loma SD	Oro Loma S.D.	Michael C. Cameron	510-481-6969	mcameron@oroloma.org	Michael Cameron, General Manager, Oro Loma Sanitary District, 2600 Grant Avenue, San Lorenzo, CA 94580	Best contact: Jeff Carson 510-481-6971. Fee, permit, plan, testing, possible treatment required. Potential problems are large sediments and amounts. May only allow discharge between 2 and 4 A.M. Service area is 40% of both Hayward and San Leandro, San Lorenzo, and some unincorporated Alameda County	Call Bill Halstead @ 510-481-6963 - he has base maps and shape files which he will make available on CD or pdf. Service area is all of San Lorenzo, parts of San Leandro, Hayward, and Castro Valley, and parts of unincorporated Alameda County. "Ora Loma is a 'district' and not subject to city boundaries..."
13	Castro Valley		Castro Valley S.D.	Roland Williams	510-537-0757	roland@cvsan.org	Roland William, General Manager, Castro Valley Sanitary District, 21040 Marshall Street, Castro Valley, CA 94546-6098	Same as Oro Loma SD - see line # A-12	Same as Oro Loma SD - see line # A-12
14	Oakland	EBMUD WPCP	EBMUD	Maura A. Bonnarens; Jannifer Smith	510-287-1141; 510-287-0509	mbonnare@ebmud.com; jsmith@ebmud.com	David R. Williams, P.O. Box 2055 (MS#702), Oakland, CA 94623-1055	Web site: www.ebmud.com or call 510-287-1651 "for determination of your permitting needs" Best contact Gail Tupper at 510-287-1608 Permit is 13 pages long (costs $650) - "every situation is different/special…"	Cities of: Alameda, Albany, Berkeley, El Cerrito, Emeryville, Kensington, Oakland, and the Stege Sanitary section of Richmond.
15	Alameda		City of Alameda	Wali Waziri	510-749-5853	wwaziri@ci.alameda.ca.us	Mat Naclerio, Director of Public Works, City of Alameda, Alameda Point, Building 1, 950 West Mall Square, Room 110, Alameda, CA 94501	Same as EBMUD WPCP - see line # A-14	Part of EBMUD see # A -14
16	Albany		City of Albany	Ann Chaney	510-528-5768	achaney@albanyca.org	Ann Chaney, Director of Community Development and Environmental Resources, City of Albany-City Hall, 1000 San Pablo Ave, Albany, CA 94706	Same as EBMUD WPCP - see line # A-14	Part of EBMUD see # A -14
17	Berkeley		City of Berkeley	Henry Yee	510-981-6303	hyee@ci.berkeley.ca.us	Rene Cardinaux, Public Works Director, City of Berkeley, 2180 Milvia St., Berkeley, CA 94704	Same as EBMUD WPCP - see line # A-14	Part of EBMUD see # A -14
18	Emeryville		City of Emeryville	Maurice Kaufman	510-596-4334	mkaufman@ci.emeryville.ca.us	Hank Van Dyke, City Engineer, City of Emeryville, 1333 Park Ave., Emeryville, CA 94608	Same as EBMUD WPCP - see line # A - 14	Part of EBMUD see # A -14
19	Oakland		City of Oakland	Fuad Sweiss; Allen Law	510-238-6607 (LR); 238-6939(AL)	fssweiss@oaklandnet.com; atlaw@oaklandnet.com	Michael Neary, Engineering Divisiion Manager, Cit of Oakland, 250 Frank Ogawa Plaza, Suite 4314, Oakland, CA 94612	Same as EBMUD WPCP - see line #A - 14	Part of EBMUD see # A -14
20	Piedmont		City of Piedmont	Larry Rosenberg	510-420-3050	lrosenberg@ci.piedmont.ca.us	Larry Rosenberg, Director of Public Works, City of Piedmont, 120 Vista Ave., Piedmont, CA 94611	Same as EBMUD WPCP - see line # A - 14	Part of EBMUD see # A -14

Alameda County - POTW Service Areas