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United States Department of the Interior

FISH AND WILDLIFE SERVICE
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IN REPLY REFER TO:
81420-2008-F-1619-4

APR 0 1 2009

Mr. Walter C. Waidelich Jr.
Federal Highway Administration
U. S. Department of Transportation
650 Capitol Mall, Suite 4-100
Sacramento, California 95814

Subject: Biological Opinion for the State Route 101 Marin-Sonoma Narrows High Occupancy Vehicle Widening Project, Marin and Sonoma Counties, California (Caltrans EA 264000) on the Threatened California Red-legged Frog and the Endangered Salt Marsh Harvest Mouse

Dear Mr. Waidelich:

This is in response to your June 18, 2008, request for formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed State Route 101 Marin-Sonoma Narrows High Occupancy Vehicle Widening Project, Marin and Sonoma Counties, California. Your request was received in this office via an electronic mail message on June 24, 2008, and included the request for formal consultation on the threatened California red-legged frog (*Rana aurora draytonii*) and the endangered salt marsh harvest mouse (*Reithrodontomys raviventris*). This document represents the Service's biological opinion on the effects of the proposed action on this listed species. This document is issued under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. § 1531 *et seq.*)(Act).

Protocol level surveys have not been completed in the action area due to scheduling issues and access problems for the soft bird's beak (*Cordylanthus mollis* ssp. *mollis*), endangered Baker's larkspur (*Delphinium bakeri*), endangered Sonoma alopecurus (*Alopecurus aequalis* var. *sonomensis*), endangered showy Indian clover (*Trifolium amoenum*), and endangered Contra Costa goldfields (*Lasthenia conjugens*). Suitable habitat is located within the action area for all of these listed plants. At this time, based on the preliminary and incomplete information provided to the Service, we concur that the proposed project may affect, but is not likely to adversely affect these five listed plant species. At a meeting with the Service on June 5, 2008, and in a letter to the Service dated June 18, 2008, the Federal Highway Administration (FHWA) stated that they will complete protocol level surveys within the action area for all of these listed

species prior to groundbreaking and reinitiate consultation pursuant to section 7 if any or all of these taxa are found, with the understanding that the presence of any or all of these plants could lead to additional conservation measures that will be determined in conjunction with the Service, project delays, project redesign, or other significant effects on the State Route 101 Marin Sonoma Narrows project.

Based on our current knowledge regarding their distribution we have determined the proposed action is not likely to adversely affect the endangered Sebastopol meadowfoam (*Limnanthes vinculans*, endangered Sonoma County Distinct Population Segment of the California tiger salamander (*Ambystoma californiense*), or the endangered California clapper rail (*Rallus longirostris obsoletus*) due to lack of appropriate habitat in the action area.

This biological opinion is based on: (1) May 2008 Biological Assessment; (2) June 19, 2008, field review; (3) additional project information provided by the California Department of Transportation (Caltrans) on August 27, 2008; (4) miscellaneous correspondence and electronic mail concerning the proposed action between the Service and Caltrans, the Transportation Authority of Marin, and the Sonoma County Transportation Authority; and (5) other information available to the Service.

Consultation History

April 21, 2008	The Service received a letter dated April 17, 2008, regarding a tentative meeting agenda and information on a proposed Least Environmentally Damaging Preferred Alternative for the Marin-Sonoma Narrows Project.
June 2, 2008	The Service received a letter dated May 30, 2008, providing a summary of the May 7, 2008, meeting to discuss the proposed Least Environmentally Damaging Preferred Alternative for the Marin-Sonoma Narrows Project.
June 5, 2008	The Service received an advance copy of the Biological Assessment for the proposed State Route 101 Marin-Sonoma Narrows High Occupancy Vehicle (HOV) Widening Project, Marin and Sonoma Counties, California, at a meeting with the FHWA and Caltrans. In the Biological Assessment, Caltrans determined that the proposed project *is likely to adversely affect* Burke's goldfields, Sonoma alopecurus, Contra Costa goldfields, Sebastopol meadowfoam, California red-legged frog, and the salt marsh harvest mouse; but *will not affect* the soft bird's beak, showy Indian clover, California tiger salamander, or the California clapper rail. The Service recommended that FHWA and Caltrans revise their current determinations to a *no effect* for the Sebastopol meadowfoam and a *may affect, not likely to adversely affect* for the five remaining listed plant species given their commitment to reinitiate consultation following completion of protocol surveys for these species within suitable habitat

within the action area prior to construction. The Service also recommended that FHWA/Caltrans consider the presence of upland and aquatic habitat for California red-legged frog on the east side of State Route 101. This was based on the existing east-west connectivity provided by culverts and bridge crossings under State Route 101, particularly in Segment B. During the meeting Caltrans requested that the biological opinion first be issued as a draft for their review.

June 19, 2008 — The Service attended a field review of the project with Caltrans, the Transportation Authority of Marin (TAM), the Sonoma County Transportation Authority (SCTA), and their consultants. Following the field review, the Service met with Caltrans, TAM, and SCTA to summarize the information requests that arose during the visit. The information requests were primarily associated with the need for more complete project description for activities at creek and river crossings.

June 24, 2008 — The Service received a letter dated June 18, 2008, from the Federal Highway Administration (FHWA) requesting formal consultation for the proposed State Route 101 Marin-Sonoma Narrows High Occupancy Vehicle (HOV) Widening Project, Marin and Sonoma Counties, California. The letter was received via an electronic mail message. In the letter, FHWA requested formal consultation on the threatened California red-legged frog, the endangered salt marsh harvest mouse, and seven listed plants. It was noted in the letter that FHWA was requesting formal consultation on seven listed plants due to their incomplete plant surveys of the action area. FHWA also outlined their plan to reinitiate consultation on the individual listed plants following the completion of additional protocol plant surveys within the action area prior to ground disturbing activities.

June 25, 2008 — The Service sent FHWA a request for additional information to adequately review the determination of the effects of the project on listed species (Service File: 81420-2008-I-1619-1). The information requested primarily focused on the need for additional project description information, particularly for those activities associated with drainage crossings. Other issues of particular focus included: the effects to salt marsh harvest mouse potential habitat under the Petaluma River Bridge; the acknowledgement of California red-legged frog habitat on the east side of State Route 101 in Segment B; the potential for California red-legged frog to occur in the more urban drainages of Segments A and C; appropriate compensation ratios to offset effects; and the previously mentioned recommended listed plant species determinations.

August 7, 2008	The Service received additional information dated August 5, 2008, from Caltrans in response to the June 25, 2008, information request and questions asked during the June 19, 2008, field visit. Of note, the Caltrans letter revised the California red-legged frog effects acreage to 206.94 acres (203.78 acres of permanent effects and 3.16 acres of temporary effects) and FHWA and Caltrans revised their effects determination for the Sebastopol meadowfoam to "no effect." Caltrans also revised their determination for soft bird's beak, Baker's larkspur, Sonoma alopecurus, and Contra Costa goldfields to a "may affect, not likely to adversely affect." Caltrans committed to completing protocol level surveys for these four listed plants within the action area prior to construction. FHWA will reinitiate consultation with the Service if a listed species is found in the action area or could otherwise be affected by the project.
August 13, 2008	The Service received a revised project description from Caltrans developed for the formal consultation process with the National Marine Fisheries Service via an electronic mail message.
August 27, 2008	The Service received a revised a complete project description from Caltrans via an electronic mail message.
August 29, 2008	The Service issued a draft biological opinion (file # 81420-2008-F-1619-2).
September 16, 2008	The Service met with FHWA, Caltrans, TAM, and SCTA to discuss the draft biological opinion.
September 19, 2008	The Service received additional project information, comments on the draft biological opinion, and September 16, 2008, meeting notes from Caltrans via an electronic mail message.
September 24, 2008	The Service received elevation contours for action area near the Petaluma Bridge from Caltrans via an electronic mail message.
September 26, 2008	The Service received comments on the draft biological opinion from FHWA.
October 9, 2008	The Service met representatives from Caltrans and CDFG to discuss the proposed geotechnical borings for the Petaluma Bridge portion of the proposed action.
December 2, 2008	The Service received project description information from Caltrans for the proposed geotechnical borings for the Petaluma Bridge portion of the

proposed action via an electronic mail message. A hardcopy of the information was received on December 3, 2008.

December 10, 2008 The Service received an electronic message from Caltrans outlining the proposed compensation language for the biological assessment. The statement proposed the fulfillment of appropriate California red-legged frog compensation through either purchase of credits at a conservation bank, establishment of a conservation easement, or fee title habitat acquisition. As stated in the message, a conservation easement would include a management plan and endowment. Caltrans referenced the Lawson's Landing property as a potential site for compensation through purchase on a conservation easement.

December 11, 2008 The Service received additional project description information from FHWA for the proposed geotechnical borings for the Petaluma Bridge portion of the proposed action and other outstanding Service information requests via an electronic mail message.

December 15, 2008 The Service received a map depicting the mean high water limits in the Petaluma River Bridge portion of the action area attached to an electronic mail message. This map was sent in response to the Service's request for information regarding available upland refuge for the salt marsh harvest mouse during high water events.

December 22, 2008 The Service issued a second draft of the biological opinion (file # 81420-2008-F-1619-3).

December 22, 2008 The Service issued a second draft of the biological opinion (file # 81420-2008-F-1619-3).

December 10, 2009 The Service received comments from Caltrans regarding the second draft of the biological opinion. The comments were attached to an electronic mail message as an undated letter that represented the consolidated comments of the SCTA, TAM, FHWA, and Caltrans.

March 5, 2009 The Service met with Caltrans and FHWA to discuss the second draft of the biological opinion (file # 81420-2008-F-1619-3).

March 27, 2009 The Service received additional information from Caltrans regarding proposed project scheduling and compensation phasing via an electronic message. The correspondence also included language related to contractor actions and compliance with the Act.

March 31, 2009 The Service received project description revisions and requested terms and conditions revisions from Caltrans via an electronic mail message.

BIOLOGICAL OPINION

Description of the Proposed Action

FHWA and Caltrans propose to construct HOV lanes on State Route 101 from just south of State Route 37 in the City of Novato to just north of Corona Road in the City of Petaluma. These transportation improvements also will include construction and modification of interchanges as well as the establishment of a new frontage road. According to Caltrans, the project is intended to reduce congestion and improve mobility while providing an incentive for commuters to use buses, carpools, or vanpools for peak period travel, and to improve freeway operations including providing safe access to and from State Route 101. The project will be referred to in the remainder of this biological opinion as the Marin-Sonoma Narrows Project.

Caltrans is in the process of developing bridge designs for the Marin-Sonoma Narrows Project and not all of the project description has been fully developed. According to the May 2008, Biological Assessment, additional design engineering will be completed for Segments B and C when funding becomes available for those segments. FHWA will reinitiate consultation with the Service if the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in this project description.

Construction Schedule and Funding

The proposed project is divided into three project segments (A, B, and C) that are further divided into sub-segments (such as A1 and B2). The overall project will be completed in two primary construction phases. Construction Phase 1 will include segments A1, B2, and B3. Construction Phase 2 will include all remaining project segments.

Construction in Phase 1 is scheduled to begin in Fiscal Year 2010/2011 (between July 1, 2010, and June 30, 2011). Construction in Phase 2 is scheduled to begin in Fiscal Year 2014/2015 (between July 1, 2014, and June 30, 2015).

The activities associated with the sub-segments are described as follows:

1. A1 consists of constructing approximately 1.5 miles of the southbound HOV lane between State Route 37 and Rowland Boulevard in Novato (Segment A), and approximately 4 miles of the northbound HOV lane between State Route 37 and Atherton Avenue in Segments A and B.

2. B1 consists of converting the existing Redwood Landfill overcrossing to a full interchange, including the construction of associated frontage roads in Segment B.

3. B2 consists of constructing a new Petaluma Boulevard South interchange including associated frontage roads in Segment B.

4. B3 is fully funded as well and consists of constructing a new mainline bridge at San Antonio Creek in Segment B. This segment would shift US-101 traffic to the west and allow the existing highway to be converted to a frontage road.

5. B4, not yet fully funded, would replace the Petaluma River bridges in Segment B and northbound State Route 116 bridge in Segment C. The southbound State Route 116 bridge, also in Segment C, would be widened as part of this phase.

Additional sub-phases are contemplated and will be defined and advanced as funding is identified.

Two upland and two aquatic geotechnical investigation bores under the Petaluma River Bridge will likely occur prior to construction of the three project segments. The bores are expected to be completed in approximately one week. Scheduling will be weather dependent to avoid boring activities and access of equipment in and out of the action area during rain and when the ground is wet. Additional borings will be accessed from the State Route 101 median and performed in areas that are not identified as listed species habitat or having the potential to adversely affect listed species.

Project Components

Caltrans has divided the approximately 16.1 mile long Marin-Sonoma Narrows Project into three segments, based on the activities occurring in each distinct segment and the construction schedule. The segments are labeled from south to north as A, B, and C. Segments A and C consist of the existing freeway in the cities of Novato and Petaluma, respectively. Segment B is the existing expressway between the two cities. The project activities are discussed by segment as follows. Caltrans has characterized the planned activities in each segment as those that will and will not affect aquatic habitat for listed species.

Segment A

HOV Lane Construction. The existing Segment A includes the existing State Route 101 roadway from State Route 101/State Route 37 Interchange and north of the Atherton Avenue Interchange through the City of Novato. The existing Segment A roadway consists of six 12-foot wide lanes (three in each direction) with 10 foot outside shoulders and 5 foot inside shoulders. The existing non-paved median between the opposite lanes of travel vary in width from 28 to 45 feet and include a double thrie-beam barrier.

According to Caltrans, the majority of the existing drainage features in the existing roadway right-of-way will remain with only minor modifications due to a lack of drainage issues.

Caltrans proposes to widen the Segment A roadway by adding a new HOV lane to each direction of travel. These new 12 foot lanes will be added to the median and will separated by a concrete barrier and varying-width inside shoulders. The new median width from the start of the project to the Atherton Avenue interchange will vary between 22 to 28 feet and will be paved. The median between the Atherton Avenue interchange and Olompali State Historic Park will vary between 28 to 44 feet with 10 foot minimum paved shoulders with the remainder unpaved.

To construct the HOV lanes, heavy equipment would be used to excavate the existing material to sub-grade for the proposed structural section. Excavated material would be tested for the presence of aerially deposited lead (ADL) and if high levels are found, Caltrans would require that the material be handled in compliance with state and federal requirements. According to an August 5, 2008 letter from Caltrans, recycled roadbed material will only be placed on areas that are classified as permanently disturbed by project activities, including material that will be used as fill or base material under the roadway. Material that exceeds the threshold for re-use would be hauled off-site to a Service-approved and/or Type 1 facility. Existing soil under the existing roadway will be used as fill. Temporary impact areas will not have stockpiles.

According to their August 5, 2008 letter, Caltrans would not place any stockpiles of material containing ADL near any sources of run-off. The contractor will place and cover stockpiles of ADL material on 0.33 millimeter thickness plastic sheeting. These stockpiles would not be placed in environmentally sensitive areas and in addition to be covered with plastic, they piles would be surrounded by either hay bales or wattles to protect them from runoff.

Dump or haul trucks would transport borrow and aggregate materials for placement and compaction. Water trucks would spray water on excavated material to maintain control of dust. Sub-base and base material would be compacted and leveled using vibratory rollers and other standard compacting equipment. Aggregate material would be placed in multiple lifts set at a maximum depth of 0.5 feet. The concrete median barrier would be placed via a concrete slip form machine. Asphalt concrete material would be hauled onto the site, and the asphalt would then be spread with a paving machine and rolled with a roller for compaction.

Sub-Grade Correction at the Rowland Interchange. According to Caltrans the existing sub-grade at the Rowland Interchange is failing due to poor soil conditions created by soft clay (Bay Mud) that is not able to support the existing roadbed.

Caltrans plans to remove 11 feet of existing fill and replace it with a lightweight fill material to stabilize the roadbed.

Caltrans will correct the sub-grade with a two-stage construction operation. Temporary lanes would be constructed to the outside of the mainline and traffic would be shifted. These new temporary lanes would require a temporary realignment of the northbound onramp at the Rowland Interchange. Once traffic is shifted, one half of the mainline would be dug out with excavation equipment and temporary retaining walls would be put in place to shore the excavation. Lightweight fill material would be placed 0.5 foot lifts and compacted with rollers. After the sub-grade has been reached and compacted, base and sub-base aggregates would be trucked and placed in 0.5 foot lifts and compacted with rollers. Asphalt concrete (AC) material would be hauled onto the site and the asphalt will then be spread with an AC paving machine and rolled with a roller for compaction. After the first stage is complete, traffic would be moved over to the median and the same process would be repeated for the outside lanes and shoulders. After the existing fill has been replaced, centerline and roadway edges would be re-striped.

Roadway Resurfacing and Striping. Caltrans plans to repair deteriorated localized sections of the existing pavement and put down an overlay on all of the existing six lanes of pavement to prevent reflective cracking and extend the service life of the roadway by 20 years. The centerline and roadway edges would be re-striped following rehabilitation.

Damaged roadway would be removed with a grinder or excavation equipment. The excavated material would be recycled and reused as embankment material for the fill section, or removed off-site. The dig-out areas would be patched with material and overlayed and striped during the rehabilitation process.

Culvert Improvements. According to Caltrans, the existing roadway drainage is conveyed by a depressed median to drainage inlets at low points in the median. There are thirty-five cross culverts that convey storm water to swales along the outside which then drain to adjacent water courses.

Caltrans proposes to replace the depressed median with new HOV lanes, shoulders, and a median barrier. The new roadway would sheet flow drainage towards the outside shoulders, away from the median. Through mainline horizontal curves when sheet flow drainage is directed towards the median due to super elevation, 27 existing drainage inlets would be reconfigured at the median. Cross culverts that are not needed would be abandoned in place and plugged. Caltrans determined that some of the cross culverts would need to be replaced due to deterioration or the need for a larger culvert.

After new cross-culvert construction has been completed, repaving methodology will be similar to those described for roadway rehabilitation. Existing cross culverts that are to

be abandoned would be capped with concrete at each end or filled with either a concrete slurry or sand.

California Highway Patrol (CHP) Pullouts, HOV Bypass Lanes, Ramp Metering. The addition of HOV Lanes would require the addition of HOV bypass lanes, CHP pullouts and ramp metering.

Caltrans proposes to widen existing on-ramps for HOV bypass lanes, CHP pullouts, and install ramp-metering infrastructure at all four of the existing interchanges in Segment A (State Route 37, Rowland, DeLong, and Atherton). An additional 12 foot lane would be added to the interchange ramps. The CHP pull outs would be 15 feet wide and 100 feet long. The length of the bypass lane will vary by ramp and all on-ramps within the action area would have HOV bypass lanes, CHP pullouts, and ramp-metering infrastructure.

The ramp widening would consist of importing fill material and placing in multiple lifts set at a maximum depth of 0.5 feet. The fill material would then be compacted between lifts until the sub-grade depth is met. Dump or haul trucks would transport aggregate materials for placement and compaction. Asphalt concrete material would be hauled to the site and then spread with an AC paving machine and rolled with a roller for compaction. Before AC is placed, electrical conduit would be trenched and placed for the ramp metering system infrastructure.

Sound Walls. Caltrans plans to erect sound walls at four locations within Segment A. The combined length of the four walls will be 4,770 feet.

The sound wall locations would be cleared and bulldozed to meet finished grade for the sound wall footing. The foundation type would depend on soil type. After the foundation is complete, a pile cap would be formed up with wood forming, steel would be placed within the cap, and concrete would be poured to complete the pile cap. If the sound wall is within 30 feet of the edge of travel way, the sound wall is required to be placed on a concrete protective barrier. Once the pile cap or the concrete barrier is in place, the concrete masonry blocks would be set and mortared to the top of the barrier or pile cap until the wall is complete.

Retaining Walls. Caltrans plans to construct retaining walls to reduce the widening needed to construct additional lanes at three existing ramps (the State Route 101/State Route 37 Southbound Connector, the DeLong Southbound On-Ramp, and the South of Rowland Southbound On-Ramp).

The retaining wall locations would be cleared and excavated with excavation equipment to reach grade for the retaining wall footing. Once grade is met, the footing would be formed, steel would be placed and the concrete would then be poured for the footing.

After the footing is poured, the same process would be used to build the stem wall. After the wall is complete, the excavated material would be backfilled and compacted.

In instances where a retaining wall is included in the design as a means of reducing the project footprint in the vicinity of sensitive resources, the following construction techniques and equipment will be used:

1. Retaining walls with spread footings: This work involves excavating through the existing shoulder backing to the substrate below using excavators and/or backhoes. The retaining walls would be constructed before the shoulder widening takes place and may involve the use of a crane from the roadway.

2. Retaining walls with pile foundations: This work involves constructing a retaining wall foundation which could include driven concrete or steel piles, cast-in-drilled-hole (CIDH) piles, or cast-in-steel shell (CISS) piles. If CIDH or CISS piles are used, a drill auger would be used to remove soil at the piles location.

3. Mechanically Stabilized Earth (MSE) retaining walls: This work involves constructing a retaining wall without a foundation. Precast concrete panels would be placed at the bottom of the wall to create the wall face. Reinforcing steel would connect to the wall panels and extend behind the wall. Fill would be placed in layers on top of the reinforcing steel and compacted in place. This procedure would be repeated until the wall is built up to the elevation of the highway.

If subsurface water is encountered during the drilling or excavation, the excavation will be de-watered under the direction of their Best Managmeent Practices (BMPs) of the Storm Water Pollution Prevention Plan (SWPPP). Residues may include aerially deposited lead material. If the residue exceeds the level of lead standards, the material would be deposited off-site at an approved location.

Structures. According to Caltrans, roadway widening would require modification to existing structures such as railing, sound walls, deck treatment, and bridges. Caltrans describes the proposed bridge work as follows.

> *Novato Creek Bridge*. There are two existing Novato Creek Bridges that are only wide enough to accommodate the three lanes of north or southbound traffic plus 5 foot inside shoulders and 8 to 10 foot outside shoulders. Both of the existing 192 foot long structures were built in 1974 and consist of a five-span continuous reinforced concrete T-beam superstructures on 18 inch +/- octagonal pre-stressed concrete pile bents (total 44 octagonal bent piles) and diaphragm type abutments on reinforced concrete piles.

Caltrans proposes to widen and connect the Novato Creek Bridges in the median to allow for the two HOV lanes and 10 foot shoulders. It is also proposed to replace the existing bridge barriers with current standard barriers. The widening of the existing bridges would include the construction of a new cast-in-place reinforced concrete T-beam superstructure, including new concrete bent caps and abutments. The substructure would consist of Class 140 driven pre-cast concrete piles at the abutments and driven CISS piles at the bents. The location and bearing for the new abutments and bents would match with the alignments of the existing abutments and bents. It is anticipated that four-2 foot diameter new CISS piles would be required per bent for a total of 16 piles for the 4 bents.

Caltrans would widen the Novato Creek Bridges by constructing and connecting the right and left parallel bridge structures to the median side of each of the existing bridge structures and closing the median gap. The existing bridge barrier would be replaced with current standard barriers. A portion of the existing overhang in the median would be removed. Access to the existing channel would be required for construction. (In Phase A1, the existing northbound structure would be widened to provide for the northbound HOV lane and shoulders. The complete widening and the ultimate connection of the northbound and southbound structures will not be completed until a future project phase.)

The construction of the CISS piles would likely include driving down the steel pipe pile into ground, removing the soil inside the steel pile, inserting bar reinforcing steel (rebar cages) into the steel pipe and filling the remaining void inside the steel pipe with concrete using a concrete pump truck. The piles would extend into the superstructure.

Existing pilings that need to be removed during construction or demolition (e.g. those in conflict with new bridge or falsework) would be removed by commonly practiced methods. These include pulling by crane or through use of vibratory methods. It may also be possible that some existing pilings can be left in place and cut off below ground.

According to Caltrans, temporary supports also known as falsework would be required to construct the superstructure. The falsework is used to support construction loads such as bar reinforcing steel, wet concrete and live loads (construction crew, equipment, etc). According to Caltrans, the falsework system usually consists of a series of falsework bents placed in the creek at certain intervals with steel beams (falsework stringers) spanning across the falsework bents. Plywood deckings are then placed between the steel beams to allow for the placement of bar reinforcing steel and forming/constructing the superstructure. The falsework bents may be constructed using braced steel or timber posts supported on timber pads placed on top of existing ground or supported on timber

or steel piles driven into the ground depending on the bearing capacity of the soil. Falsework piles may be completely removed or cut below the ground elevation and left in place.

Types of hammers used in piling installation would conform to Caltrans Standard Specifications (49-1.05). Impact hammers would be steam, hydraulic, air or diesel hammers sufficient to drive piles at a penetrations rate of not less than 1/8 inches per blow at the specified nominal resistance. Vibratory hammers would not be used for installation of permanent piles unless shown on the plans or specified in the special provisions. Caltrans might use vibratory hammers to install shoring, coffer dam or falsework piles unless otherwise restricted in the Contract Special Provisions or as listed in permits.

Once the falsework is complete the reinforced concrete T-beam superstructure would be constructed. After completion of the structure, all temporary falsework material would be removed, the creek banks would be stabilized and erosion control BMP's would be placed.

The Novato Creek Bridge work will be located approximately 28 meters east of potential salt marsh harvest mouse habitat. In their August 5, 2008 letter, Caltrans maintained that the bridge work will be accessed from the opposite side of the existing bridge and this pickleweed habitat would be effectively avoided.

Storm Water Quality Systems and Construction Site BMPs. The proposed project would incorporate bio-filtration strips, swales, and Austin sand filters to receive storm water discharges from the highway or other impervious surfaces. The project will also likely include off-site storm water treatment.

Bio-filtration strips would be located at the base of fill slopes and graded to flow perpendicular to the mainline. Bio-filtration swales would also be located at the base of fill slope and convey water parallel with the main line. Swales would be a graded trapezoidal channel with side slopes of 4:1 or flatter.

Bio-filtration strips and swales have the same means of construction. A backhoe and excavator would be used to excavate and set grade for the channel. After the channel is graded, it would be planted with a vegetative species that has filtration properties.

An Austin sand filter is a two-chamber device with the first chamber used to settle out larger sediment and meter flow into the second chamber. The second chamber is a sand media filter that removes the finer particulates from the influent. The treated effluent is then discharged back into the drainage system.

Construction Site BMPs. To maintain water quality during construction, Caltrans would implement BMPs to reduce unnecessary water quality impacts. The following methods and practices would be implemented:

1. Earth dikes/drainage swales and lined ditches
2. Outlet protection/velocity dissipation devices
3. Check dams
4. Silt fencing with maintenance openings
5. Fiber rolls
6. Concrete washouts
7. Drainage inlet protection
8. Construction entrance/exit protection

Staging Locations. Staging locations would be used for temporary storage of heavy construction equipment and construction materials, equipment maintenance shops, stockpile areas, and field offices. The primary staging area in Segment A would be located within the interchange at the South Novato overcrossing. According the Caltrans project description, areas that are located within the State Right-of-Way and quantified as within the project area of effect may also be used, subject to approval of the contractor submitted SWPPP. Contractors may independently seek off-site staging locations. Off-site staging locations will be subject to the requirements of resource agencies and permits will be the responsibility of the contractor.

Segment B

Nonstandard Shoulders, Vertical and Horizontal Curves. The existing State Route 101 roadway in Segment B is a four-lane expressway with two 12 foot wide lanes in each direction. Most of the existing roadway in this segment does not meet current horizontal alignment, vertical profile and sight distance requirements for the 70 mile per hour corridor design speed. The shoulders are variable width, with the outside shoulders varying from 5 to 8 feet and the inside shoulders varying from 2 to 4 feet. The non-paved median varies in width from 11 to 51 feet and contains a double thrie-beam barrier.

Caltrans plans to improve the Segment B roadway design by upgrading the existing nonstandard shoulders, constructing a HOV lane in each direction, and bringing vertical and horizontal curves to current standards. The proposed project design would include 10 foot shoulders with a concrete median barrier. Nonstandard vertical and horizontal curves would be brought to current standards to meet stopping sight distance requirements. Within the concrete medians, Type S barriers for wildlife crossing would be installed every 20 feet and Type M wildlife crossings would be installed every 0.25 miles. Type S barriers are a type 60 concrete barrier with a 6 inch diameter opening at the base of the barrier for small animal passage. Type M wildlife crossings are a type 60

concrete barrier with a 2-foot break in the barrier, with the break protected by a thrie-beam guard rail to deflect vehicle traffic.

Caltrans proposes to realign the roadway mainline to correct vertical and horizontal curves throughout Segment B.

The proposed horizontal alignment would shift from the existing alignment throughout Segment B to correct nonstandard curves. Approximately 75% of the existing alignment would be reconstructed with a new structural section. The additional 25% of Segment B would utilize the existing roadway alignment and would be widened in the median for HOV lanes and shoulders.

According to Caltrans, the proposed vertical alignment would correct nonstandard curves. The locations of the profile corrections are from approximately 229 feet south of the Redwood Landfill OC to approximately 3280 feet north of the OC; from approximately 656 feet south of San Antonio Creek to Gambini Road, and from South Kastania Road to the Petaluma River Bridge. Through these areas the proposed profile would shift the new roadway up to 28 feet above or up to 24 feet below the existing roadway.

Due to the rolling terrain in Segment B, Caltrans will use two methods for the construction of the proposed roadway realignment. When the alignment is shifted through a hillside, material would be cut from the hillside until finished grade is met. Typical equipment to be used for this method would include excavators, bulldozers, earth movers, and compaction equipment. Excess fill cut from other locations within the project would be used in areas where the roadway needs to be built up. This material would either be hauled in by trucks for long hauls, or from earth moving equipment for short hauls. Once the fill material is hauled in, it will be placed in multiple lifts set at a maximum depth of 0.5 feet. Fill material would then be compacted between lifts until the sub-grade depth is met. Dump or haul trucks would then transport aggregate materials for placement and compaction. Asphalt concrete material will be hauled to the site and then spread with an AC paving machine and rolled with a roller for compaction.

Upgrade Expressway to Freeway with the Addition of Frontage Roads. Residents, ranches, and other land uses are only directly accessible off of State Route 101 in Segment B. There are currently 31 driveways and seven at-grade intersections that connect directly to State Route 101. Also in Segment B there is no other north-south bicycle passage other than on the shoulder of State Route 101. These conditions make the State Route 101 through Segment B an expressway rather than a freeway. Caltrans proposes to upgrade Segment B to a freeway by constructing off-ramps to new frontage roads. Local access and bicycle traffic will be moved to frontage roads or a dedicated bicycle and pedestrian facility.

Therefore the proposed project will convert the existing expressway in Segment B to an access-controlled freeway. Converting the existing expressway would require reconfiguring the existing Landfill Overcrossing into an interchange, reconfiguring the Petaluma Boulevard South interchange, and building a frontage road system to maintain access to intersecting roadways and adjacent parcels, as well as replacing bicycle and pedestrian access. Bicycle access will be moved to frontage roads or a dedicated bicycle and pedestrian facility.

As previously described, due to the rolling terrain in Segment B, Caltrans will use two methods for the construction of the proposed roadway realignment. When the alignment is shifted through a hillside, material would be cut from the hillside until finished grade is met. Typical equipment to be used for this method would include excavators, bulldozers, earth movers, and compaction equipment. Excess fill cut from other locations within the project would be used in areas where the roadway needs to be built up. This material would either be hauled in by dump trucks for long hauls, or from earth moving equipment for short hauls. Once the fill material is hauled in, it will be placed in multiple lifts set at a maximum depth of 0.5 feet. Fill material would then be compacted between lifts until the sub-grade depth is met. Dump or haul trucks would then transport aggregate materials for placement and compaction. Asphalt concrete material will be hauled to the site and then spread with an AC paving machine and rolled with a roller for compaction.

Culvert Improvements. As described for Segment A, existing drainage in Segment B is conveyed by a depressed median to drainage inlets at low points in the median. Cross culverts convey the storm water to swales along the outside which drain to adjacent water courses.

The roadway realignment would replace the depressed median with new HOV lanes, shoulders, and a median barrier. These improvements would cause the sheet flow to drainage towards the outside shoulders, away from the median. Through mainline horizontal curves, where sheet flow drainage is directed towards the median due to super elevation, existing drainage inlets would be reconfigured at the median. Cross culverts that are no longer needed would be abandoned in place.

Caltrans determined that the majority of culverts are still in a state of good repair and function adequately. Some systems will require replacement due to deteriorated conditions or resizing to handle additional flow.

As described for culvert work in Segment A, Caltrans determined that some of the cross culverts would need to be replaced due to deterioration or the need for a larger culvert.

Caltrans plans to abandon unneeded culverts in place. The extension of existing box culverts may require accessing creeks.

According to an August 5, 2008 Caltrans letter, Caltrans is considering adding cross culverts, where feasible, in Segment B specifically to provide wildlife passage under State Route 101.

After new cross-culvert construction has been completed, repaving methodology will be similar to those described for roadway rehabilitation. Existing cross culverts that are to be abandoned would be capped with concrete at each end and filled with either a concrete slurry or sand.

Recurring Flooding and Culvert Improvements. Caltrans plans to replace or upgrade the majority of the drainage facilities through Segment B due to their age, capacity or condition. There are two locations, San Antonio Creek and Gunn Lane, where roadway flooding has been a problem.

Caltrans plans to realign and raise the road profile through San Antonio Creek and near Gunn Lane to alleviate recurring flooding and replace the majority of the existing culvert systems due to the proposed realignment or deteriorated condition. Cross culverts would be sized to pass design-year flows with a minimum diameter of 24 inches for maintenance and approximately 79 new cross culverts will be added.
Caltrans plans to address the flooding issue by building a fill section with a higher profile through the area. This would be constructed using the previously described methods for constructing nonstandard shoulders, vertical and horizontal curves. During construction of the new fill sections, cross-culverts would be placed as the fill section is being built. Existing drainage systems that only require extensions or reconfigurations would be installed as previously described for Segment A.

Retaining Walls. Caltrans plans to construct retaining walls to avoid a historic residence near Kastania Road, trees on the new frontage road at the Landfill Interchange, and salt marsh harvest mouse habitat near the northbound off-ramp at the Petaluma Boulevard, South Interchange.

The retaining walls near Kastania Road and the Landfill Interchange locations would be one of the three types described for Segment A.

The retaining wall near the Landfill Interchange would be a soil nail or tieback retaining structure. Soil would be excavated from the top of the wall down approximately 5 to 10 feet to the first tieback or soil nail location. Horizontal drill equipment would drill holes along the length of the wall and a post tensioned tieback tendons or soil nails would be installed and grouted in place. If post tensioned tiebacks are used, a reinforced concrete whaler would be constructed at the tieback location horizontally across the wall. Tendons would be post tensioned and locked against the concrete whaler. In either case, reinforcing steel would be placed in front of the excavation and shotcrete would be placed against the excavated hillside. If soil nails are used, they would be locked against steel

plates. The hillside would then be excavated to the next tieback or soil nail location and the process would be repeated to reach the bottom of the wall. A reinforced concrete or shotcrete facing would then be constructed to complete the wall.

Utility Relocations. The project design in Segment B would require a significant number of intricate utility relocations. According to Caltrans, the exact location and condition of the existing facilities would not be determined until positive location (potholing) work has been completed. As the designs of these relocations proceed, the remaining service life of the existing individual facilities would be calculated and a cost/benefit analysis would be performed to determine the feasibility of their retention. If retention appears to be the preferred alternative, encroachment exceptions would be requested on a case-by-case basis. Otherwise, the utility will be relocated at a location within the project footprint. Depending on the nature of the utility relocations, FHWA may reinitiate Section 7 consultation to address any additional effects to listed species not described in this biological opinion.

Structures. The proposed project includes modifications to several bridges. Of these, the San Antonio Creek Bridge (mainline), San Antonio Creek Bridge (frontage road), and the Petaluma River Bridge all cross over bodies of water, and are discussed below. Although bridge designs have not been determined, Caltrans stated in their August 5, 2008, letter that the described action area is based on the alternative with the largest footprint.

San Antonio Creek Bridge (mainline). The existing San Antonio Creek Bridges are located within an area of recurring flooding. The new San Antonio Creek Bridge would be built on a realigned portion of State Route 101, west of the existing highway, with a raised profile. The bridge is proposed as a cast-in-place concrete pre-stressed box girder with reinforced concrete bent caps and abutments. The existing northbound structure would be used for a new frontage road creek crossing and the southbound structure would be removed.

Two structure alternatives are proposed for the new bridge. Alternative 1 is a five-span structure, 634.8 feet long by 115.2 feet wide, with 4 columns per bent for a total of 16 columns for the 4 bents. Alternative 2 is a three-span structure, 428.1 feet long by 115.2 feet wide, with 4 columns per bent for a total of 8 columns for the two bents. The bridge layout for Alternative 1 and Alternative 2 are similar except that Alternative 2 includes a Mechanically Stabilized Earth (MSE) wall at abutment 1 which would result in a shorter bridge. The substructure would consist of reinforced concrete columns and abutments supported on a concrete pile cap with driven pre-cast concrete piles. The column size is expected to be approximately 5.5 feet in diameter. Each column footing size is approximately 22 by 22 by 6 feet deep. There would be approximately 25 piles per column footing. The dimensions of the pre-cast concrete pile are approximately 1.24 x 1.24 feet.

It is anticipated that the construction footprint would extend 50feet beyond each side of the edge of bridge deck. Access to the existing channel would be required for construction.

To construct the new bridge, soil at the abutment locations would be re-graded to raise the profile. If Bridge Alternative 2 is selected, the MSE wall would be constructed as the profile is raised at Abutment 1. After the profile is raised at the abutment locations, the precast concrete piles would be driven into the ground. A reinforced concrete footing would be constructed on top of the piles. Then, a reinforced concrete abutment would be constructed on the pile cap.

The contractor would excavate soil at the column footing locations. If water is anticipated at the footing elevations, cofferdams consisting of driven sheet pilings would be construction around the perimeter of the footings. If needed, cofferdams would be approximately 32 by 32 feet per column footing. After cofferdams are placed, soil would be excavated to the footing elevation. The column footing piles would then be driven with an impact hammer. If water is encountered, it would be pumped from the cofferdam to trucks or a sediment basin permitted by the Water Quality Control Board. A lean concrete seal course might be placed to minimize water intrusion. Reinforced concrete pile caps and columns would be constructed at each column footing.

To construct the new superstructure, temporary supports also known as falsework would be required. The falsework is used to support construction loads such as bar reinforcing steel, wet concrete and live loads (construction crew, equipment, etc.). The falsework system usually consists of a series of falsework bents placed at certain intervals with steel beams spanning across the falsework bents. Plywood decking is then placed between the steel beams to allow for the placement of bar reinforcing steel and forming/constructing the superstructure. The falsework bents might be constructed using steel or braced timber posts supported on timber pads which have been placed on top of existing ground or steel piles that have been driven into the ground depending on the bearing capacity of the soil. Once the falsework is complete the reinforced concrete box girder superstructure would be constructed. After completion of the structure, all temporary cofferdam and falsework material would be removed, the creek banks would be stabilized and erosion control BMP's would be placed. Falsework piles may be completely removed or cut below the ground elevation and left in place.

Bridge removal work would consist of breaking and removing the existing concrete structure. Over land, the bridge would be dropped in sections onto filter fabric or similar material and removed. Over the creek, the contractor would use approved BMP's to protect the creek from falling debris.

San Antonio Creek Bridge (frontage road). The existing historic San Antonio Creek Bridge on San Antonio Road is approximately 101 feet long and 23 feet wide. According to Caltrans the existing structure is not wide enough to provide two new12 foot-wide lanes and 5 foot wide shoulders and the historic nature of the structure does not allow it to be widened. Therefore Caltrans plans to build a new bridge to cross San Antonio Creek. The existing structure will be re-striped for a one-way bridge and a bike lane.

Two structure alternatives are proposed for the new San Antonio Creek bridge. Alternative 1 is proposed as a cast-in-place concrete slab with reinforced concrete bent caps and abutments. This seven-span bridge is approximately 227.5 feet long and 42 feet wide. The substructure would consist of Class 140 driven precast concrete piles at the abutments and driven cast-in-steel shell piles at the bents. Caltrans anticipates that five 2-foot diameter new CISS piles will be required per pier for a total of thirty for the 6-piers. Alternative 2 is proposed as a cast-in-place concrete pre-stressed box girder with reinforced concrete bent caps and abutments. This new two-span bridge would be approximately 235 feet long and 42 feet wide. The substructure would consist of reinforced concrete columns (total two) approximately 4 feet in diameter and abutments that are supported on a concrete pile cap with driven pre-cast concrete piles. The size of the column footings is approximately 28 by 28 by 6 feet. Each column footing would have approximately 25 driven piles. The size of each pile is approximately 15 x 15 inches.

Caltrans anticipates that the area required for construction activities would extend 50 feet beyond each side of the edge of bridge deck. Access to the existing channel would be required for construction.

To construct the new bridge, soil at the abutment locations would be re-graded to raise the profile. After the profile is raised at the abutment locations, the precast concrete piles would be driven into the ground. A reinforced concrete footing would be constructed on top of the piles. Then, a reinforced concrete abutment would be placed on the pile cap.

If Alternative 1 is selected, the contractor would drive CISS piles into the ground at column locations. The soil inside the steel shells would be drilled out, a reinforcing steel cage would be placed inside the shell, and concrete would be placed by a pump. The foundation piles would be extended as columns into the deck slab.

If Alternative 2 is selected, the contractor would excavate soil at the column footing locations. If water is anticipated at the footing elevations, cofferdams consisting of driven sheet pilings would be construction around the perimeter of

the footings. If needed, cofferdams would be approximately 38 by 38 feet per column footing. After cofferdams are placed, soil would be excavated to the footing elevation. The column footing CISS piles would then be driven with an impact hammer. If water is encountered, it would be pumped from the cofferdam to trucks or a sediment basin permitted by the Water Quality Control Board. A lean concrete seal course might be used to minimize water intrusion. The soil inside the steel shells will be dug out, a reinforcing steel cage would be placed inside the shell, and concrete would be placed by a pump. Reinforced concrete pile caps and columns would be constructed at each column footing.

To construct the superstructure, temporary supports also known as falsework would be required. The falsework would be used to support construction loads such as bar reinforcing steel, wet concrete and live loads (construction crew, equipment, etc). According to Caltrans, the falsework system usually consists of a series of falsework bents placed at certain intervals with steel beams spanning across the falsework bents. Plywood decking is then placed between the steel beams to allow for the placement of bar reinforcing steel and forming/constructing of the superstructure. The falsework bents might be constructed using steel or timber posts supported on timber pads which have been placed on top of existing ground or on timber or steel piles that have been driven into ground depending on the bearing capacity of the soil. Access to the existing channel would be required for pile driving, pile cap construction and falsework construction. Once the falsework is complete the reinforced concrete slab or box girder superstructure would be installed. After completion of the structure, all temporary cofferdam and falsework material would be removed, the creek banks would be stabilized and erosion control BMP's would be installed. Falsework piles may be completely removed or cut below the ground elevation and left in place.

Petaluma River Bridge. The existing Petaluma River Bridge on State Route 101 consists of two separate structures, each 885 feet long and 31 feet wide. The bridges were built in 1955.

Due to the age of the existing structures and the costs associated with bringing them up to current standards, it is proposed to replace the two existing bridges with a single bridge. There is an existing fender system protecting the bridge bents at each side of the waterway. This fender system would be removed during construction in order to facilitate bridge construction work. The new bridge would increase the span over the waterway to 210 feet long and the new Pier 3 would be located above the waterway limit. A new bridge fender system would likely be required for Pier 4 even though it would be located closer to the north bank.

Caltrans has proposed two structure alternatives for the new bridge. Both alternatives would include construction of an 855 foot long and 115 foot wide, five-span bridge. Alternative 1 would consist of a reinforced concrete box girder superstructure. Alternative 2 would consist of a Precast/Pre-stressed Concrete Bulb "T" girder superstructure. The substructure for both alternatives consists of reinforced concrete column piers supported on spread footings or on pile caps with either cast-in-drilled hole (CIDH) or cast-in-steel shell (CISS) pilings. Both alternatives would include between 3 to 5 columns per pier for a total of between 12 to 20 columns for the 4 piers. The size of the individual column footings would be approximately 35 by 28 by 7 feet deep. Caltrans anticipates that each column footing would consist of between twenty-five to forty 18-inch to 30-inch diameter CIDH or CISS pilings for each of the twelve to twenty columns.

Geotechnical investigation will be needed prior to construction of the new Petaluma River Bridge. The purpose of the investigation is to characterize the subsurface conditions and to evaluate engineering properties of the soils and/or rock for the design development of the replacement of the Petaluma River Bridge. As part of the geotechnical investigation for the proposed improvements of Segment B4 of the Marin Sonoma Narrows project, four borings, ranging from 50 to 100 feet in depth, are planned to investigate the bents of the proposed Petaluma River Bridge Replacement located north of the Petaluma River. Two of the bore sites will be located in the designated temporary staging areas and the other two will be located in the Petaluma River. Additional borings will be accessed from the State Route 101 median and performed in areas that are not identified as listed species habitat or having the potential to adversely affect listed species. The drilling will be completed using a track-mounted drill rig, a truck-mounted drill rig, or a potable drill rig may be used to access the slopes along the east side of the freeway between the Petaluma River Bridge and the 101/116 Separation and Overhead, and the banks of the Petaluma River. A skid-mounted drill rig attached to a sectional barge will be used to explore the bent on the river bank and in the river. Drilling will be completed using rotary wash methods; the size of the borehole will be about 5 inches in diameter.

Prior to the start of the field investigation Underground Service Alert (USA) will be contacted at least 48 hours before the start of work to clear underground utilities. All boring locations will also be cleared utilizing the services of a private underground utility locator. Some locations may require that the boring first be advanced using a hand auger to a depth of at least 3 feet to check for underground utilities, and then be advanced with the drill rig.

Boring permits are required by County of Sonoma, Department of Health Services, Environmental Health Division, for completion of the borings. The permit applications will be processed by consultant, URS. The borings will be

completed during daylight hours. Traffic control will be provided during drilling pursuant to Caltrans standards and as specified in the encroachment permit. A traffic control specialty contractor will be retained to provide traffic control for other borings, where required.

Sampling in the borings will be completed at 5-foot intervals or closer intervals at changes in material type as the drilling progresses. Caltrans anticipates that the majority of the sampling will be completed using a Standard Penetration Test (SPT) or Modified California (MC) sampler. If soft cohesive soils are encountered thin-walled Shelby tube samples will also be obtained.

All soil cuttings generated during the drilling of the borings will be placed in drums and stored at an offsite location designated by Caltrans. The soil cuttings in the drums will be sampled for waste characterization (approximately 1 sample for 3 drums) and disposed of at the nearest non-hazardous waste landfill following reception of the analytical testing results and acceptance of the materials for disposal. If analytical results indicate that the soil cuttings cannot be disposed of at the nearest non-hazardous landfill further testing and analysis may be required to dispose of the drums of soil at an appropriate facility.

Waste associated with the drilling operation such as drilling fluid, material containers, and personal trash will be placed in drums or containers and moved offsite for proper disposal.

All drilling equipment and vehicles will access the drill locations using an existing designated road/path. Access will be confined to this designated route to minimize effects to adjacent pickleweed habitat for the salt marsh harvest mouse.

The two upland borings (R-08-005 and R-08-006) will be explored by using a track mounted rig. The exploration for the two borings in the Petaluma River (R-08-005A and R-08-005B) is planned using a skid-mounted CME 45 rotary drill rig attached to a sectional barge that would be floated to the proposed locations at appropriate high tide levels. The remaining proposed borings will be explored with a truck-mounted rotary drill rig.

For rotary drilling, a one-ton service truck equipped with a water tank will support the drill rig. In general, the drill rig will access the site at the beginning the job and be parked over night until drilling is complete. On the other hand, the service truck will access the site in the morning at the beginning of each shift of drilling and leave the site at the end of the day to refill for the next day. It will leave the site during the day only if the drill hole requires more water for the drilling fluid mixture. The service truck will also be used to transport drill waste containers and soil cutting drums.

The new Petaluma River Bridge would be constructed in three stages. During Stage 1, the middle portion of the new bridge would be built in between the two existing structures and the existing median barriers would be removed. During Stage 2, the existing southbound structure would be removed for the new bridge construction. During stage 3, the northbound structure would be removed to allow for the construction of the final portion of the new bridge. Pile driving for the column footings will occur year-round. Other construction activities that will occur year-round on land include: bridge demolition, vegetation clearing and planting, and road construction for site access, removal of existing piles, falsework removal and cleanup, and concrete pouring (which may involve some work over water using appropriately sealed forms).

Access to the existing channel would be required for construction. The contractor would access the north bank of the river from State Route 116 along the east side of State Route 101. The contractor would access the south bank of the river from Petaluma Boulevard South. Piers 2 and 5 are located above the banks of the Petaluma River. Pier 3 is located on land at the edge of the south bank the river. Pier 4 is located in the river, adjacent to the north bank. Caltrans anticipates that the contractor would need to construct a trestle bridge to gain access to Pier 4 and to gain access to the north side of Pier 3. The trestle would also need to be extended around the existing piers for demolition of the existing bridge and towards the center of the channel for falsework, temporary erection tower, and temporary fender pile installation. A navigational opening would be maintained for mariners on the Petaluma River. The size of the opening would be negotiated and subject to approval of the U.S. Coast Guard. At the north and south sides of the opening a temporary fender system consisting of driven piles and steel and timber barriers would be placed to protect the falsework and/or erection towers from being hit from a vessel. The contractor would drive piles in the river and place a timber deck on the pilings to create a work platform or trestle above the river. The maximum trestle size is estimated at 1000 by 36 feet. Trestle and temporary fender piles would be either steel H-piles or steel pipe piles. Pipe would be approximately 20 to 24 inches in diameter. Piles would initially be driven with a vibratory hammer. Bearing would be confirmed with an impact hammer. Caltrans anticipates that a maximum of 300 temporary trestle and fender piles would be needed. Trestle and fender piles would be between 20 to 45 feet deep and would be installed between June 15 and October 31 of any year. Caltrans estimates that the contractor would install approximately 2 to 10 trestle and/or fender piles per day. Trestle and fender piles would be installed on approximately 20 to 75 days over a three year period. When an impact hammer is used to confirm bearing, each pile would receive approximately 5 to 20 strikes. If required for noise reduction, trestle piles would be driven inside a double walled isolation casing when an impact hammer is used.

Cofferdams consisting of sheet pilings will then be installed around the perimeter of Piers 3 and 4 footings. It is anticipated that one large cofferdam approximately 135 by 38 feet would be installed per pier location. Cofferdams might also be used at Piers 2 and 4, if ground water is anticipated. Four additional cofferdams approximately 39 by 22 feet would be used during demolition of the existing column footings in the river. Cofferdams would be constructed of interlocking sheet pilings, which would be driven by a vibratory hammer. If difficult driving is encountered, an impact hammer might be used for the final few feet of installation. Cofferdams would be installed between June 15 and October 31 of any year.

According to the August 5, 2008, Caltrans letter an existing ditch that contains pickleweed and acts as a connector between two pickleweed areas on the east and west sides of the existing Petaluma River Bridges. Caltrans would construct a new bridge pier and footing at the site of the existing ditch. A new ditch would be constructed slightly south of the existing ditch to maintain flow regimes during construction. The new ditch would be culverted for three years so construction equipment can access the area to construct the new pier and footing. Once construction is complete, Caltrans would restore the ditch, which will include removing the culvert and grading it to mimic the current ditch, including the same elevation, topography, and vegetation. This will be done in order to encourage the pickleweed to self-propagate as it has in the existing ditch.

The pickleweed removal would be the first order of work at the Petaluma River Bridge, prior to any heavy equipment being brought onto the site. The pickleweed will be removed by hand and the area is expected to be re-vegetated based on previous pickleweed propagation information. Caltrans makes this assumption based on other projects such as the Guadalcanal Tidal Marsh Restoration Project on State Route 37 in Solano County where a levee was breached and pickleweed self-propagated within several years.

Additionally, the construction access road would require an approximate 25-foot long temporary culvert in the vicinity of the SMART railroad bridge. Currently drainage traverses into the Petaluma River via an open ditch that contains some pickleweed. This culvert will also be in place for approximately 3-years, during construction. At the conclusion of construction, the culvert will be removed and the ditch will be restored to pre-construction conditions

Caltrans has developed minimization and avoidance measures to address potential adverse effects to listed salmonids and will implement those measures according to the separate biological opinion issued by National Marine Fisheries.

After cofferdams are completed and cleared of salmonid issues by the fisheries biologist, the contractor would install permanent foundation piles and the soil would be excavated to the footing elevation. If final design indicates CIDH piles, the contractor would likely use temporary steel casings at pile locations to help prevent caving and control water. CIDH piles would be constructed by drilling holes to the pile tips. Slurry would also likely be placed in the holes to control water and prevent caving. Once drilling is complete, a reinforcing steel cage would be placed in the hole and concrete would be pumped to the bottom of the hole, displacing the slurry, which would be pumped into holding tanks. If final design indicates CISS piles, Caltrans anticipates that the contractor would initially drive the piles with a vibratory hammer and complete driving into bedrock with an impact hammer. Piles at Piers 3 and 4 are estimated to be between 30 to 50 feet long and each pile will receive between 200 to 600 strikes. Piles will extend to bedrock and the contractor would likely install between 2 to 20 CISS piles per day. The contractor would likely be driving piles at Piers 3 and 4 with an impact hammer for up to 60 days over an 18 month period. CISS would be installed year round from completed trestle and cofferdams. If required for noise reduction, bubble curtains would be used around CISS piles, inside of cofferdams at Piers 3 and 4, when driving with an impact hammer. After piles are driven, soil would be excavated from inside the pile shells by drilling. Slurry would likely be pumped inside the shells to displace water. A reinforcing steel cage would be placed inside the shell, and structural concrete would be pumped to the bottom of the shell, displacing the slurry. Slurry would be pumped to holding tanks.

After piles are constructed, a seal course of lean concrete would likely be placed at the bottom of the footing to prevent water intrusion. Water would be pumped from the cofferdam into a baker tanks or a sediment basin permitted by the Water Quality Control Board. Then, a reinforced concrete footing cap and columns would be constructed on top of the pilings.

To construct the superstructure, temporary supports also known as falsework would be required for Alternative 1 and temporary erection towers would be needed for Alternative 2. The falsework would be used to support construction loads such as bar reinforcing steel, wet concrete and live loads (construction crew, equipment, etc). According to Caltrans, the falsework system usually consists of a series of falsework bents placed at certain intervals with steel beams spanning across the falsework bents. Plywood decking is then placed between the steel beams to allow for the placement of bar reinforcing steel and forming/constructing the superstructure. The falsework bents might be constructed using steel or timber posts supported on timber pads which have been placed on top of existing ground or on timber or steel piles that have been driven into ground depending on the bearing capacity of the soil. Temporary erection towers are needed to provide temporary support and a work platform for splicing precast concrete bulb T-

Girders. Erection towers would be supported by piles driven in the water. Steel and/or timber posts, beams, and lateral supports would complete the tower to the bottom of the superstructure elevation. Falsework or temporary erection piles would be either steel H-piles or steel pipe piles. The pipe would be approximately 20 to 24 inches in diameter. Piles would initially be driven with a vibratory hammer. Bearing would be confirmed with an impact hammer. It is estimated that a maximum of 160 falsework or temporary erection piles would need to be driven in Petaluma River. Falsework or temporary erection piles would be between 20 to 45 feet deep and would be installed between June 15 and October 31 of any year. Caltrans estimates that the contractor would install approximately 2 to 20 falsework or temporary erection piles per day. Trestle piles would be installed on approximately 20 to 80 days over a three year period. When an impact hammer is used to confirm bearing, each pile would receive approximately 5 to 20 strikes. If required for noise reduction, falsework or temporary erection piles would be driven inside a double walled isolation casing when an impact hammer is used.

After the completion of the Stage 1 bridge construction, the existing northbound bridge would be removed. After the completion of the Stage 2 bridge construction, the existing southbound bridge would be removed. For the portion of the structure over the waterway, the structure would likely be removed by saw cutting between precast concrete girders and then using crane(s) to lift the girders out of place. Subject to the engineer's approval, the crane(s) would likely be located at the adjacent spans of the bridge or barge cranes would be utilized to remove the girders. Bridge removal protective cover, if necessary, would be attached to the existing bridge soffit/bents. Cofferdams of approximately 39 feet long by 22 feet wide each (total 4) would be required for the removal of the existing columns and/or spread footings at Pier 5 and Pier 6. Access would be gained by using the temporary trestle.

For bridge demolition work on non-waterway areas, the columns would likely be tipped over and demolished on ground or on protective ground cover such as crane mats etc. Existing footings in water and on banks would be removed to a required minimum elevation or distance below original ground.

After completion of the new bridge, all temporary cofferdam, temporary fender system, temporary erection tower, and falsework material would be removed. Piles would be removed by vibrating and/or pulling the piles with a crane. Alternatively, the piles may be cut at an elevation specified by the U.S. Coast Guard and left in place below existing grade. A new permanent pier protective system consisting of either a closed fill system or a fender system of driven piles and barriers would be placed to protect the new bridge Pier 4. The permanent fenders would consist of approximately 60 driven piles. Piles would be made of

steel pipe, steel H, or timber. Pipe would be approximately 20 to 24 inches in diameter. Piles would initially be driven with a vibratory hammer. Bearing would be confirmed with an impact hammer. Permanent fender piles would be between 20 to 45 feet deep and would be installed between June 15 and October 31 of any year. It is estimated that the contractor would install approximately 2 to 20 permanent fender piles per day. Permanent piles would be installed during approximately 3 to 15 days over a three year period. When an impact hammer is used to confirm bearing, each pile would receive approximately 5 to 20 strikes. If required for noise reduction, permanent fender piles would be driven inside a double walled isolation casing when an impact hammer is used.

The creek banks would then be stabilized and erosion control BMP's would be implemented.

Storm Water Quality Systems and Construction Site BMPs. The proposed project would incorporate bio-filtration strips and swales to receive storm water discharges from the highway or other impervious surfaces. The project would also likely include off-site storm water treatment.

The Segment B on-site storm water treatment would include bio-filtration strips, bio-filtration swales, and Austin sand filters. The installation of these features were discussed in the Segment A project description.

Construction Site BMPs. To maintain water quality during construction, Caltrans would implement BMPs to reduce unnecessary water quality impacts. The following methods and practices would be implemented:

1. Earth Dikes/Drainage Swales and Lined Ditches
2. Outlet Protection/Velocity Dissipation Devices
3. Check Dams
4. Silt Fencing with Maintenance Openings
5. Fiber Rolls
6. Concrete Washouts
7. Drainage Inlet Protection
8. Construction Entrance/Exit Protection

Staging Locations. Caltrans would use staging locations for temporary storage of heavy construction equipment and construction materials, equipment maintenance shops, stockpile areas, and field offices. The primary staging areas in Segment B would be located within the new interchange at the Sanitary Landfill Road (Station 1405-1409), at the new interchange off of Kastania Road (Station 2039-2045), and below and along the sides of the Petaluma River Bridge (Station 2053-2055). Caltrans proposes areas that are located within the State Right-of-Way and quantified as within the project area of effect,

subject to approval of the contractor submitted SWPPP. Contractors may independently seek off-site staging locations. Off- site staging locations will be subject to the requirements of resource agencies and permits will be the responsibility of the contractor.

Segment C

HOV Lane Construction. The existing State Route 101 Segment C roadway travels through the City of Petaluma. This segment is classified as a freeway, and includes two 12 foot lanes in each direction, 10 foot outside shoulders and 5 foot inside shoulders. The majority of existing curves in Segment C meet current horizontal alignment, vertical profile and sight distance requirements for the 70 mile per hour corridor design speed with the exception of the Petaluma Overhead. The existing Petaluma Overhead vertical profile is nonstandard and would be brought to current standards with this project. The non-paved median varies in width from 28 to 35 feet and contains a double thrie-beam barrier. The majority of the drainage facilities through Segment C can be utilized with only minor modifications and no historical drainage issues or recurring flooding has been documented.

In Segment C, Caltrans proposes to add a 12 foot wide HOV lane in each direction between south of the Lakeville Highway/State Route 116 Interchange and north of the Corona Road Overcrossing. The new roadway would be separated by a concrete barrier and would include 10 foot-wide inside shoulders. The majority of the widening would be in the median, with some outside widening. The roadway would be reconstructed at the approaches to the North Petaluma Overhead to correct the existing nonstandard vertical alignment. The proposed profile would be a new roadway located up to 17 feet above the existing roadway.

The HOV roadway construction would be completed as described for Segment A.

Vertical Curve Correction at the Petaluma Overhead. Caltrans plans to reconstruct the vertical profile through the Petaluma Overhead to achieve standard specification and replace the structure. The work would be completed in three stages. The first stage would consist of constructing the median portion of the overhead and fill the section leading up to both sides of the structure. Temporary retaining walls would be set in place for the fill section and imported material would be trucked in and placed in 0.5 foot lifts. Each lift would be spread and compacted with grading compacting equipment. The structural section would then be placed and compacted using the same methodology as described for HOV construction. Once the median is constructed, northbound traffic would be shifted to the median, and the same process would be used to construct the northbound portion of the vertical curve correction. Finally, northbound traffic would be moved to the new northbound lanes and southbound traffic would be shifted to the median for construction of the southbound lanes.

Roadway Resurfacing and Striping. Roadway resurfacing and striping for Segment C would use the same methodology as that described for Segment A.

Culvert Improvements. As described for the previous segments existing roadway drainage in Segment C is conveyed by a depressed median to drainage inlets at low points in the median. Segment C includes fifteen cross culverts that convey storm water to swales along the outside of the roadway which drain to adjacent water courses.

Caltrans would replace the depressed median with new HOV lanes, shoulders, and a median barrier. These improvements would result in sheet flow drainage towards the outside shoulders, away from the median. Sixteen existing drainage wells will be reconfigured at the median in Segment C. Cross culverts that are no longer needed would be abandoned in place and plugged. Caltrans has determined that most of the existing culverts are adequate but some would require replacement due to deterioration and improper sizing.

The construction methods for removing, installing, and extending culverts are as described for Segment A.

CHP Pullouts, HOV Bypass Lanes, and Ramp Metering. The addition of CHP pullouts, HOV bypass lanes, and ramp metering in Segment C will be similar to the methodology described for Segment A. These features will be added Landfill, Petaluma Boulevard South, State Route 116/Lakeville, and East Washington interchanges.

Sound Walls. Caltrans will construct new sound walls at four locations within Segment C. These locations include Ponderosa Drive to East Washington, North of Lynch Creek, Napa Drive to Corona Road, and East Washington to north of Lynch Creek. The combined length of the new walls would be approximately 12,230 feet.

Retaining Walls. Caltrans plans to construct three retaining walls for structural reasons in Segment C. The walls will be located north on both sides of the Petaluma Bridge and from McGregor Avenue Drive to East Washington. The combined length of the retaining walls in Segment C would be 3,635 feet long and will vary between 4 and 7 feet high. The walls will be constructed as described in Segment A.

Structures. Six bridges would be modified for the widening and include the structures at Route 101/116, Caulfield Lane, East Washington Street, Washington Creek, Lynch Creek, and North Petaluma. Only the two creek crossings are further described as follows.

Washington Creek Bridge. The existing 67 foot-long Washington Creek Bridges accommodate two 12 foot-wide lanes of traffic and one 2 foot-wide inside shoulder and a 4 foot-wide outside shoulder in each direction.

Caltrans plans to widen both bridges in order to add the 12 foot wide HOV lane along with 10 foot-wide shoulders and HOV bypass. The existing twin bridges will be widened by connecting the right and left bridges and matching the existing structures to make a total width of 139.8 feet. It is also proposed that the existing bridge barriers with current standard barriers be replaced.

Access to the existing channel would be required for construction. Widening would involve the construction of a new cast-in-place reinforced concrete slab superstructure including new concrete bent caps and abutments. The substructure would consist of class 140 driven steel shell piles approximately 1.2 feet in diameter at the abutments and piers. Caltrans anticipates that there would be 11 new driven steel shell piles (pier columns) per pier for a total of 22 for the two piers. The piles would extend into the superstructure.

The Washington Creek Bridge would be constructed using the same methods described for Segment B.

Lynch Creek Bridge. The two Lynch Creek Bridges are only wide enough to accommodate two 12 foot wide lanes along with 2 foot wide inside shoulders and 4 foot wide outside shoulders. Both of the existing bridges were built in 1955 and consist of a three-span continuous reinforced concrete slab superstructure on reinforced concrete pile bents and reinforced concrete "U" open abutments.

As with the Washington Creek Bridge, Caltrans plans to widen the Lynch Creek Bridges to accommodate an additional 12 foot-wide HOV lane, 10 foot wide shoulders, and a ramp taper. Caltrans also plans to replace the existing bridge barriers with current standard barriers.

Access to the existing channel would be required for construction. Caltrans would widen the Lynch Creek Bridge by constructing and connecting parallel bridge structures to the median side of each of the existing bridge structures and closing the median gap as well as constructing and connecting a parallel bridge structure to the northbound side of the existing bridge. Caltrans would construct the widened portions of the bridge similar to the existing structure so that the widened portions match the existing structure in strength, durability, and flexibility.

Caltrans also plans to construct a sound wall on a bridge barrier on the southbound side of the structure. According to Caltrans, the widening of the existing bridge would require the construction of new a cast-in-place reinforced concrete slab superstructure including new concrete bent caps and abutments. The substructure consists of Class 140 (12 by 12 inch) driven precast concrete piles

Caltrans anticipates that there would be 10 new driven precast concrete piles (pier columns) per pier for a total of 20 piles for the 2 piers. The piles would extend into the superstructure.

The location and bearing for the new abutments and bents would match with the alignments of the existing abutments and bents. The use of falsework and erosion control BMPs would be similar to that used for the other bridges in this project.

Storm Water Quality Systems and Construction Site BMPs. Segment C would use the same BMPs as described for Segment B.

Construction Site BMPs. Segment C would use the same BMPs as described for Segment B.

Staging Locations. Caltrans would use staging locations for temporary storage of heavy construction equipment and construction materials, equipment maintenance shops, stockpile areas, and field offices. The primary staging areas in Segment C would be located within the State Route 116 Interchange. Caltrans proposes to use areas that are located within the State Right-of-Way and quantified as within the project area of effect, subject to approval of the contractor submitted SWPPP. Contractors may independently seek off-site staging locations. Off- site staging locations will be subject to the requirements of resource agencies and permits will be the responsibility of the contractor.

Construction Site Restoration

Caltrans plans to restore areas of temporary ground disturbances, including storage and staging areas, and temporary roads. These areas 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. Caltrans defines areas of "temporary" disturbance to be any area that is disturbed during the project, but that after project completion will not be subject to further disturbance and has the potential to be revegetated. Caltrans will be developing a restoration plan that will be submitted to the Service for comment prior to initial ground breaking. According to Caltrans, to the maximum extent practicable (i.e., presence of natural lands), topsoil will be removed, cached, and returned to the site according to successful restoration protocols. Loss of soil from run-off or erosion will be prevented with straw bales, straw wattles, or similar means provided they do not entangle, block escape or dispersal routes of listed animal species.

Proposed Avoidance and Minimization Measures

According to the May 2008 Biological Assessment and the revised project description provided by Caltrans on August 27, 2008, FHWA/Caltrans propose to avoid, minimize, and compensate for effects to listed species by implementing the following measures:

Federally Listed Plants

If listed plants may be affected by the project, Caltrans will implement the following:

1. Minor design modifications will be made to avoid effects to listed plant species.

2. Any area where federally listed plants and/or populations have been observed within the temporary work area will be designated an Environmentally Sensitive Area and marked in the field with orange construction fencing.

3. The location of all Environmentally Sensitive Area's will be shown on project construction drawings and noted for monitoring during construction.

4. Preconstruction botanical surveys will be conducted prior to construction during the appropriate time of year (during spring and early summer), by qualified botanists familiar with the regional flora, and will follow Service, California Department of Fish and Game, and CNPS approved protocols.

California Red-Legged Frog

1. To compensate for the potential effects to 203.78 acres of California red-legged frog habitat Caltrans and FHWA will provide compensation at a 1:1 ratio totaling approximately (203.78 acres). This compensation, which is being provided pursuant to CEQA/NEPA and FHWA policies on mitigating effects to natural lands, and which is incorporated as part of the project description, will be achieved using a combination of the following:

    a. Purchasing credits at a resource agency approved mitigation bank servicing the action area;

    b. Purchasing conservation easements at or as close to the project site as practical within Marin and/or Sonoma Counties;

    c. Purchasing fee title and preserving the land for California red-legged frog at or as close to the project site as practical within Marin and/or Sonoma Counties.

Compensation may be provided by Caltrans itself or to the extent feasible with the assistance of a state or local partner such as a park or open space district or a resource conservation district. Compensation for California red-legged frog will be provided before or concurrent with the project effects to California red-legged frog for each project Construction Phase.

2. A Service-approved biologist(s) will be designated for the construction phase activities in Segment B and Segment C that will affect California red-legged frog habitat. The qualified biologist(s) will be on-site during specific construction activities for each construction phase work in potential California red-legged frog habitat. The qualifications of the biologist(s) will be presented to the Service for review and written approval prior to ground-breaking at the project site. The biologist(s) will coordinate through the Resident Engineer, to stop any work that may result in take of the California red-legged frog. If work is stopped, the biologist(s) will notify the Service by telephone and electronic mail within one (1) working day. The Service contact will be Chris Nagano, Division Chief, Endangered Species Program at the Sacramento Field Office at telephone (916) 414-6600.

3. The Resident Engineer will halt work and immediately contact the Service-approved project biologist(s) and the Service in the event that a California red-legged frog gains access to a construction zone. The Resident Engineer will suspend construction activities in the immediate construction zone within Segment B and Segment C for each specific project phase that may affect California red-legged frog habitat until the animal leaves the site voluntarily or is removed by the biologist(s) to a release site using Service-approved handling techniques.

4. All construction supervisory personnel for each specific project phase within Segment B and Segment C that are working in areas of potential endangered species habitat will attend an environmental education program delivered by the Service approved biologist prior to working on the project site. The program will include an explanation as how to best avoid the accidental take of California red-legged frogs. The Service approved biologist(s) will conduct a training session that would be scheduled as a mandatory informational field meeting by the Caltrans Resident Engineer for all construction contractor supervisory personnel. The field meeting will include topics on species identification, life history, descriptions, and habitat requirements during various life stages. Emphasis will be placed on the importance of the habitat and life stage requirements within the context of project maps showing areas where minimization and avoidance measures are being implemented. The program will include an explanation of appropriate federal and state laws protecting endangered species as well as the importance of compliance with Caltrans and various resource agency conditions.

5. To minimize temporary disturbances in areas of potential California red-legged frog habitat, project related vehicle traffic within Segment B and Segment C for construction phases with potential California red-legged frog habitat will be restricted to established roads, construction areas, and other designated areas. These areas also should be included in pre-construction surveys and, to the maximum extent practicable, should be established in locations disturbed by previous activities to prevent further adverse effects. Project related vehicles will observe a 20-mile per hour speed limit within Segment B and Segment C for construction phases with potential California red-legged frog habitat, except on County roads, and State and Federal highways. Off-road traffic outside of designated action areas of Segment B and Segment C for construction phases with potential California red-legged frog habitat will be prohibited.

6. Dust control measures will be implemented within Segment B and Segment C for construction phases with potential California red-legged frog habitat, consisting of regular truck watering of constriction access areas and disturbed soil areas with the use of organic soil stabilizers to minimize airborne dust and soil particles generated from graded areas. Regular truck watering will be a requirement of the construction contract. In addition, for disturbed soil areas, an organic tackifier to control dust emissions blowing off of the right-of-way or out of the construction area during construction will be included in the contract special provisions. Watering guildelines for dewatering will be established to avoid any excessive run-off that may flow into contiguous areas. Any material stockpiles will be watered, sprayed with tackifier or covered, to minimize dust production and wind erosion.

7. Project employees will be provided with written guidance governing vehicle use, speed limits on unpaved roads, fire prevention, and other hazards.

8. To eliminate an attraction to predators of the California red-legged frog, 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 action area.

9. To avoid injury or death of a California red-legged frog, no firearms will be allowed in the action area except for those carried by authorized security personnel, or local, State, or Federal law enforcement officials.

10. To prevent harassment, injury or mortality of a California red-legged frog or destruction of their refuge, project personnel will not be permitted to have dogs or cats in the action area.

11. Use of rodenticides and herbicides in the action area will be used in such a manner to prevent primary or secondary poisoning of a California red-legged frog and the depletion of vegetation on which they depend. All uses of such compounds will observe label and other restrictions mandated by the U.S. Environmental Protection Agency, California Department of Food and Agriculture, and other appropriate State and Federal regulations, as well as additional project-related restrictions deemed necessary by the Service or the California Department of Fish and Game.

12. Dedicated fueling and refueling practices will be designated as part of the approved SWPPP. Dedicated fueling areas will be protected from storm water run-on and run-off and will be located at least 50 feet from downslope drainage facilities and water courses. Fueling must be performed on level-grade areas. On site fueling will only be used where it is impractical to send vechicles and equipment off-site for fueling. When fueling must occur on-site, the contractor will designate an area to be used subject to the approval of the Resident Engineer, representing Caltrans. Drip pans or absorbent pads will be used during on-site vehicle and equipment fueling.

13. All grindings and asphaltic-concrete waste will be stored within previously disturbed areas absent of California red-legged frog habitat and at a minimum of 150 feet from any downstream riparian habitat, aquatic habitat, culvert, or drainage feature.

14. For each specific project phase within Segment B and Segment C, and to the extent practicable, areas outside of the construction zones containing suitable habitat for the California red-legged frog will be delineated with high visibility temporary fencing at least 4 feet in height, flagging, or other barrier to prevent encroachment of construction personnel and equipment onto sensitive areas during construction activities. The fencing will be removed only when all construction equipment is removed from the site. No project activities will occur outside the delineated project construction area.

15. If requested, before, during, or upon completion of ground breaking and construction activities, Caltrans will allow access by Service personnel to the action area to inspect project effects to California red-legged frogs and their habitats. Due to safety concerns, Caltrans requests that Service staff check in with the Resident Engineer prior to accessing the construction site.

16. For work on each construction phase within Segment B and Segment C that may affect California red-legged frog habitat, a Service-approved biologist(s) will be on-site to monitor the initial ground disturbance activities for the road construction. The biologist(s) will perform a clearance survey immediately prior

to the initial ground disturbance. Safety permitting, the Service-approved biologist(s) will investigate areas of disturbed soil for signs of listed species within thirty (30) minutes following the initial disturbance of that given area.

17. To prevent inadvertent entrapment of California red-legged frogs during work within construction Phase B4, all excavated, steep-walled holes or trenches more than 2 feet deep will be covered at the close of each working day by plywood or similar materials. Alternatively, an additional 4-foot high vertical barrier, independent of exclusionary fences, may be used to further prevent the inadvertent entrapment of California red-legged frogs. If it is not feasible to cover an excavation or provide an additional 4-foot high vertical barrier, independent of exclusionary fences, one or more escape ramps constructed of earth fill or wooden planks will be installed. 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 will be contacted by telephone for guidance. The Service will be notified of the incident by telephone and electronic mail within one working day.

18. Plastic mono-filament netting (erosion control matting) or similar material will not be used at the project site because California red-legged frogs may become entangled or trapped in it. Acceptable substitutes include coconut coir matting or tackified hydroseeding compounds.

19. Injured California red-legged frogs will be cared for by a licensed veterinarian or other qualified person such as the on-site biologist; dead individuals must be placed in a sealed plastic bag with the date, time, location of discovery, and the name of the person who found the animal; the carcass should be kept in a freezer; and held in a secure location. The Service and the California Department of Fish and Game will be notified within one (1) working day of the discovery of death or injury to a California red-legged frog that occurs due to project related activities or is observed at the project site. Notification will 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 at the Sacramento Fish and Wildlife Office (916/414-6600), and Dan Crum, Resident Agent-in-Charge of the Service's Law Enforcement Division at 916/414-6660. The California Department of Fish and Game contact is Mr. Scott Wilson at telephone (707) 944-5563. 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

20. Caltrans will submit post-construction compliance reports for each Segment B and Segment C construction phase with potential California red-legged frog habitat, prepared by the on-site biologist, to the Service within sixty (60) calendar days following completion of each phase with potential California red-legged frog habitat or within sixty calendar days of any break in construction activity lasting more than sixty calendar days. This report will detail (1) dates that construction occurred; (2) pertinent information concerning the success of the project in implementing avoidance and minimization measures for listed species; (3) an explanation of failure to meet such measures, if any; (4) known project effects on California red-legged frogs, if any; (5) occurrences of incidental take of any of these species; (6) documentation of employee environmental education; and (7) other pertinent information. The reports will be addressed to the Deputy Assistant Field Supervisor of the Endangered Species Program, Sacramento Field Office of the Service.

Salt Marsh Harvest Mouse

Caltrans stated in their August 5, 2008 letter that the following measures would be implemented during activities associated with the Petaluma Bridge. Caltrans will avoid potential salt marsh harvest mouse habitat adjacent to the action area at other locations.

1. Caltrans will begin restoration of all salt marsh harvest mouse pickleweed and upland habitat associated with the action area to baseline or better conditions following the completion of construction at the Petaluma River Bridge. Successful establishment of baseline or better salt marsh harvest mouse pickleweed habitat should be achieved within three years.

2. A Service and the California Department of Fish and Game approved biologist will be designated for construction activities for Construction Phase B4. The qualified biologist(s) will be on-site during specific construction activities for each project activity that may have adverse effects to the salt marsh harvest mouse. The qualifications of the biologist(s) will be presented to the Service and the California Department of Fish and Game for review and written approval prior to ground-breaking at the project site. The biologist(s) will coordinate through the Resident Engineer, to stop any work that may result in take of these listed animal species. If work is stopped, the biologist(s) will notify the Service and the California Department of Fish and Game by telephone and electronic mail within one working day. The Service contact will be Chris Nagano, Division Chief, Endangered Species Program at the Sacramento Field Office at telephone (916) 414-6600. The California Department of Fish and Game contact is Mr. Scott Wilson at (707) 944-5563.

3. The Resident Engineer will halt work and immediately contact the Service and California Department of Fish and Game approved biologist and the Service and the California Department of Fish and Game in the event that a salt marsh harvest mouse gains access to a construction zone. The Resident Engineer will suspend construction activities in the immediate construction zone for work in Construction Phase B4 that could have adverse effects to the salt marsh harvest mouse until the animal leaves the site voluntarily.

4. All supervisory construction personnel for Construction Phase B4 that are working in areas of potential endangered species habitat will attend an environmental education program delivered by the Service and California Department of Fish and Game approved biologist prior to working on the project site. The program will include an explanation as how to best avoid the accidental take of salt marsh harvest mouse. The Service and California Department of Fish and Game approved biologist(s) will conduct a training session that would be scheduled as a mandatory informational field meeting by the Caltrans Resident Engineer for all construction contractor supervisory personnel. The field meeting will include topics on species identification, life history, descriptions, and habitat requirements during various life stages. Emphasis will be placed on the importance of the habitat and life stage requirements within the context of project maps showing areas where minimization and avoidance measures are being implemented. The program will include an explanation of appropriate federal and state laws protecting endangered species as well as the importance of compliance with Caltrans and various resource agency conditions.

5. To minimize temporary disturbances for work in areas of potential salt marsh harvest mouse habitat, project related vehicle traffic within Construction Phase B4 will be restricted to established roads, construction areas, and other designated areas. These areas also should be included in preconstruction surveys and, to the maximum extent practicable, should be established in locations disturbed by previous activities to prevent further adverse effects. Project related vehicles will observe a 20-mile per hour speed limit within Construction Phase B4, except on County roads, and State and Federal highways. Off-road traffic outside of designated action areas within Construction Phases B2 and B4 will be prohibited.

6. Dust control measures will be implemented within Construction Phase B4, consisting of regular truck watering of constriction access areas and disturbed soil areas with the use of organic soil stabilizers to minimize airborne dust and soil particles generated from graded areas. Regular truck watering will be a requirement of the construction contract. In addition, for disturbed soil areas, an organic tackifier to control dust emissions blowing off of the right-of-way or out of the construction area during construction will be included in the contract special provisions. Watering guildelines for dewatering will be established to

avoid any excessive run-off that may flow into contiguous areas. Any material stockpiles will be watered, sprayed with tackifier or covered, to minimize dust production and wind erosion.

7. Project employees will be provided with written guidance governing vehicle use, speed limits on unpaved roads, fire prevention, and other hazards.

8. To eliminate an attraction to predators of the salt marsh harvest mouse, 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 action area.

9. To avoid injury or death of the salt marsh harvest mouse, no firearms will be allowed in the action area except for those carried by authorized security personnel, or local, State, or Federal law enforcement officials.

10. To prevent harassment, injury or mortality of a salt marsh harvest mouse or destruction of their refuge/nesting areas by dogs or cats, project personnel will not be permitted to have dogs or cats in the action area.

11. Rodenticides and herbicides in the action area will be used in such a manner to prevent primary or secondary poisoning of salt marsh harvest mouse and the depletion of vegetation on which they depend. All uses of such compounds will observe label and other restrictions mandated by the U.S. Environmental Protection Agency, California Department of Food and Agriculture, and other appropriate State and Federal regulations, as well as additional project-related restrictions deemed necessary by the Service or the California Department of Fish and Game.

12. Dedicated fueling and refueling practices will be designated as part of the approved SWPPP. Dedicated fueling areas will be protected from storm water run-on and run-off and will be located at least 50 feet from downstream drainage facilities and water courses. Fueling must be performed on level-grade areas. On site fueling will only be used where it is impractical to send vechicles and equipment off-site for fueling. When fueling must occur on-site, the contractor will designate an area to be used subject to the approval of the Resident Engineer, representing Caltrans. Drip pans or absorbent pads will be used during on-site vehicle and equipment fueling.

13. All grindings and asphaltic-concrete waste will be stored within previously disturbed areas absent of salt marsh harvest mouse habitat and at a minimum of 150 feet from any downslope riparian habitat, aquatic habitat, culvert, or drainage feature.

14. To minimize or avoid the loss of individual salt marsh harvest mice from construction activities in the Petaluma River area, pickleweed vegetation will be hand-removed. Following removal, a special 2-foot high fence consisting of plastic sheeting will be placed 20 feet from the boundaries of construction areas in and adjacent to the pickleweed areas after the vegetation is removed. The fence will be held in place with 2-inch wide and 3-foot long stakes and will be buried in a 6 to 8 inch deep trench to prevent mice from pushing under the fence. These methods will occur with the approval of and in coordination with the California Department of Fish and Game.

15. Prior to commencing construction work for Contract Phase B4 that can have adverse effects to salt marsh harvest mouse, and to the extent practicable, areas outside of the construction zones containing suitable habitat for salt marsh harvest mouse will be delineated with high visibility temporary fencing at least 4 feet in height, flagging, or other barrier to prevent encroachment of construction personnel and equipment onto sensitive areas during construction. The fencing will be removed only when all construction equipment is removed from the site. Actions within the action area will be limited to vehicle and equipment operation on existing roads. No construction activities will occur outside the delineated project construction area.

16. Caltrans will minimize effects on potential habitat at Location 4 by restricting construction to within 100 feet of the existing Caltrans ROW. The closest potential habitat for salt marsh harvest mouse was found approximately 150 feet from the existing Caltrans ROW.

17. If requested, before, during, or upon completion of ground breaking and construction activities, Caltrans will allow access by the Service and/or California Department of Fish and Game personnel to the project site to inspect project effects to the salt marsh harvest mouse and their habitats. Due to safety concerns, Caltrans requests that Service staff check in with the Resident Engineer prior to accessing the construction site.

18. For work within Construction Phase B4 that could have adverse effects to salt marsh harvest mouse, a Service and California Department of Fish and Game approved biologist will be on-site to monitor the initial ground disturbance activities for the road construction. The biologist will perform a clearance survey immediately prior to the initial ground disturbance. Safety permitting, the Service and California Department of Fish and Game approved biologist(s) will investigate areas of disturbed soil for signs of listed species within thirty (30) minutes following the initial disturbance of that given area.

19. To prevent inadvertent entrapment of salt marsh harvest mouse during construction, all excavated, steep-walled holes or trenches more than 2 feet deep will be covered at the close of each working day by plywood or similar materials. Alternatively, an additional 2-foot high vertical barrier, independent of exclusionary fences, may be used to further prevent the inadvertent entrapment of salt marsh harvest mice. If it is not feasible to cover an excavation or provide an additional 2-foot high vertical barrier, independent of exclusionary fences, one or more escape ramps constructed of earth fill or wooden planks will be installed. 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 California Department of Fish and Game will be contacted by telephone for guidance. The Service will be notified of the incident by telephone and electronic mail within one working day.

20. Injured salt marsh harvest mice will be cared for by a licensed veterinarian or other qualified person such as the on-site biologist; dead individuals must be placed in a sealed plastic bag in which a piece of paper is placed that contains the date, time, location of discovery, and the name of the person who found the animal; the carcass should be kept in a freezer; and held in a secure location. The Service and the California Department of Fish and Game will be notified within one (1) working day of the discovery of death or injury to a salt marsh harvest mouse that occurs due to project related activities or is observed at the project site. Notification will 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 at the Sacramento Fish and Wildlife Office (916/414-6600), and Dan Crum, Resident Agent-in-Charge of the Service's Law Enforcement Division at 916/414-6660. The California Department of Fish and Game contact is Mr. Scott Wilson at telephone (707) 944-5563. 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.

21. Caltrans will submit a post-construction compliance report for Construction Phase B4 prepared by the on-site biologist to the Service within sixty (60) calendar days following completion of Construction Phase B4 or within sixty (60) calendar days of any break in construction activity lasting more than sixty calendar days. This report will detail (1) dates that construction occurred; (2) pertinent information concerning the success of the project in implementing avoidance and minimization measures for listed species; (3) an explanation of failure to meet such measures, if any; (4) known project effects on the salt marsh harvest mouse, if any; (5) occurrences of incidental take of this listed species; (6) documentation

of employee environmental education; and (7) other pertinent information. The report will be addressed to the Deputy Assistant Field Supervisor of the Endangered Species Program.

According to the revised project description received by the Service on December 2, 2008, Caltrans plans to implement the following measures during the geotechnical investigation activities associated with construction of the Petaluma Bridge.

1. When accessing the designated temporary staging area, located between the north bank of Petaluma River and the toe of the north approach embankment, a qualified biologist will monitor the site access path taken by the drilling equipment. Along the access path near any salt marsh harvest mouse habitat designated by the biologists, plywood boards (4 feet by 8 feet) will be placed to temporarily form a pathway for the drilling equipment. A steel plate will be used to provide temporary crossing platform of a drainage ditch.

2. Maintain all vehicles and drill rigs will be inspected frequently and maintained to repair leaks.

3. Drip pans or drop cloths will be used to catch drips and spills. Drain and replace motor oil, radiator coolant, or other fluid will be conducted off site. All spent fluids will be collected, stored in labeled separate containers, and recycled whenever possible. All fuels, oils and lubricants will be kept within secondary containment.

4. Perform major maintenance, repair jobs and vehicle and equipment washing will be performed off-site when feasible, or in designated and controlled areas on-site.

5. Vehicles will be washed at an appropriate off-site facility. If equipment must be washed on-site, water will be prevented from entering the storm drain or open channel. Use of soaps, solvents, degreasers, or steam cleaning equipment will be prohibited. Wash water will be directed to an area that will not flow to any storm drain inlets or open channels.

6. Vehicles and heavy equipment will be refueled in one designated location on the site and spills will be cleaned up immediately.

7. A biological monitor will hold daily tail gate meeting prior to start of drilling activities.

8. Plastic sheeting or visqueen will be placed over the drill site to catch spills and drips of drilling fluids.

9. Straw waddle will be placed on top of visqueen to form a temporary dike surrounding the drill hole and circulation tub to contain spills.

10. Absorbents will be made available to clean up any leaks or spills.

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 action area includes all lands associated with the approximately 786.402 acre project footprint and roads (except for County roads, and State and Federal highways) and other areas accessed by project vehicles.

Status of the Species and Environmental Baseline

California Red-Legged Frog

The California red-legged frog was listed as a threatened species on May 23, 1996 (Service 1996). Please refer to the final rule and the *Recovery Plan for the California Red-Legged Frog (Rana aurora draytonii)* (Service 2002) for additional information on this species.

This threatened species is the largest native frog in the western United States (Wright and Wright 1949), ranging from 1.5 to 5.1 inches 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 lighter centers (Stebbins 2003) and dorsolateral folds are prominent on the back. Larvae (tadpoles) range from 0.6 to 3.1 inches in length, and the background color of the body is dark brown and yellow with darker spots (Storer 1925).

Red-legged frogs have paired vocal sacs and vocalize in air (Hayes and Krempels 1986). Female frogs deposit egg masses on emergent vegetation, allowing the egg mass floats on 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.

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 species historically was documented in 46 counties but the taxa now remains in 238 streams or drainages within 23 counties. This represents 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. This listed amphibian is believed to be extirpated from the southern Transverse and Peninsular ranges, but is still present in Baja California, Mexico (California Department of Fish and Game 2004).

Adult California red-legged frogs prefer dense, shrubby or emergent riparian vegetation closely associated with deep (>2.3 feet), still, or slow-moving water (Hayes and Jennings 1988). However, frogs also have been found in ephemeral creeks and drainages and in ponds that may or may not have riparian vegetation. The largest densities of red-legged frogs currently are associated with deep pools with dense stands of overhanging willows (*Salix* species) and an intermixed fringe of cattails (*Typha latifolia*) (Jennings 1988). Red-legged frogs disperse upstream and downstream of their breeding habitat to forage and seek sheltering habitat.

California red-legged frogs also can be found in disturbed areas such as channelized creeks and drainage ditches in urban and agricultural areas. An adult California red-legged frog recently was observed in a shallow isolated pool on North Slough Creek in the American Canyon area of Napa County (Christine Gaber/PG&E personal communication with Chris Nagano/Service on October 22, 2008). This frog location was surrounded by vineyard development. Another adult California red-legged frog was observed under debris in an unpaved parking lot in a heavily industrial area of Burlingame (Patrick Kobernus communication with Michelle Havens on October 16, 2008). This Burlingame frog was likely utilizing a nearby drainage ditch. Caltrans has also discovered California red-legged frog adults, tadpoles, and egg masses within a storm drainage system within a major cloverleaf intersection of Millbrae Avenue and State Route 101 in a heavily developed area of San Mateo County (Caltrans 2007). California red-legged frog has the potential to persist in disturbed areas as long as they provide at least one or more of their life history requirements.

According to Feller and Kleeman (2007), non-breeding dry season habitat includes several characteristics: 1) sufficient moisture to allow the frogs to survive throughout the non-breeding season that may be up to 11 months long ; 2) sufficient cover to moderate temperatures during the warmest and coldest times of the year; and 3) protection (e.g., deep pools in a stream, or complex cover such as root masses or thick vegetation) from predators such as hawks and owls, herons, and small carnivores.

During other parts of the year, habitat includes nearly any area within 1-2 miles 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 bush (*Baccharis pilularis*), California blackberry thickets (*Rubus ursinus*), and root masses associated with willow (*Salix* species) and California bay trees (*Umbellularia californica*). 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 wide coyote bush 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 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.

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 records of a few individuals moving up to 1-2 miles (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). Dispersing frogs in northern Santa Cruz County traveled distances from 0.25 miles to more than 2 miles without apparent regard to topography, vegetation type, or riparian corridors (Bulger *et al.* 2003). Fellers and Kleeman (2007) and Bulger et al. (2003) found that California red-legged frog migration corridors can be less "pristine" (e.g., closely grazed fields, plowed agricultural lands) than breeding or non-breeding habitats. Bulger *et al.* (2003) observed that this listed ranid did not avoid or prefer any landscape feature or vegetation type. They tracked individuals that crossed agricultural land, including recently tilled fields and areas with mature crops. The threats facing migrating California red-legged frogs during their movements include being run over by vehicles on roads (Gibbs 1998; Vos and Chardon 1998), degradation of habitat (Vos and Stumpel 1995; Findlay and Houlahan 1997; Gibbs 1998), predation (Gibbs 1998), and dessication (Rothermel and Semlistch 2002; Mazerolle and Desrochers 2003).

Egg masses contain about 2,000 to 5,000 moderate sized (0.08 to 0.11 inches in diameter), dark reddish brown eggs and are typically attached to vertical emergent vegetation, such as bulrushes (*Scirpus* species) or cattails (Jennings *et al.* 1992). 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). Eggs hatch in 6 to 14 days (Jennings 1988). 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 3.5 to 7 months after hatching (Storer 1925; Wright and Wright 1949; Jennings and Hayes 1990). 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 red-legged frogs is highly variable. Hayes and Tennant (1985) found invertebrates to be the most common food items. According to their data, vertebrates, such as Pacific tree frogs and California mice (*Peromyscus californicus*) represent over half the prey mass eaten by larger frogs (Hayes and Tennant 1985). Hayes and Tennant (1985) found juvenile frogs to be active diurnally and nocturnally, whereas adult frogs were largely nocturnal. The diet of red-legged frogs is not well studied, but their diet is likely similar to other ranid frogs that feed on algae, diatoms, and detritus by grazing on the surface of rocks and vegetation (Fellers 2005; Kupferberg 1996a, 1996b).

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* species), goldfish (*Carassius auratus*), common carp (*Cyprinus carpio*), and mosquitofish (L. Hunt, in litt. 1993; S. Barry, in litt. 1992; S. Sweet, in litt. 1993). 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 disappearance of red-legged frog populations once bullfrogs became established at the same site (L. Hunt, in litt. 1993; S. Barry, in litt. 1992; S. Sweet, in litt. 1993). 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, in litt.1993; R. Stebbins in litt. 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 adversely affected 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. The conversion and isolation of perennial pool habitats resulting from urbanization is an ongoing impact to red-legged frogs.

The California red-legged frog may be susceptible to many of the same pathogens, fungi, water mold, bacteria, and viruses have been known to adversely affect tiger salamander species or other amphibians. As with the California tiger salamander, Chytridiomycosis and ranaviruses may be a particular developing concern for California red-legged frog populations. Mao *et al.* (1999 cited in Fellers 2005) reported northern red-legged frogs infected with an iridovirus, which was also presented in sympatric three-spined 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). Nonnative species, such as bullfrogs and nonnative tiger salamanders, are both located within the range of the California red-legged frog and have been identified as potential carriers of these diseases. Human activities can facilitate the spread of disease by encouraging the further introduction of non-native carriers and by acting as carriers themselves (i.e. contaminated boots or fishing equipment). Human activities can also introduce stress by other means, such as habitat fragmentation, that results in red-legged frogs being more susceptible to the effects of disease. Disease will likely become a growing threat because of the relatively small, fragmented remaining California red-legged frog breeding sites, the many stresses on these sites due to habitat losses and alterations, translocation of infected animals, and the many other potential disease-enhancing anthropogenic changes which have occurred both inside and outside the species' range.

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. The Marin-Sonoma Narrows Project is within Recovery Unit 3 (North Coast and North San Francisco Bay) (Service 2002).

Project Segments A and C cross through urbanized area with little potential upland red-legged frog habitat but with urban creek crossing that include degraded riparian habitat and non-native predators of this animal. Although urban, Washington and Lynch creeks in Segment C have well developed riparian cover within their confines and provide habitat for California red-legged frogs.

The habitat in and surrounding the action area of Segment B is rural and characterized by rolling oak grasslands and creeks with well-developed riparian systems. The development in Segment B is primarily limited to several large ranches and the dominate land use is cattle grazing. Based on the habitat conditions it appears likely that there is suitable upland and aquatic red-legged frog habitat throughout Segment B. According to Caltrans assessment, potential California red-legged frog habitat on both sides of the roadway that would be affected in Segment B amounts to 206.94 acres. Therefore, the Service has determined it is reasonable to conclude the California red-legged frog inhabits and has the potential to be encountered within 206.94 acres of the action area, based on the biology and ecology of the species, and the presence of suitable habitat.

Salt Marsh Harvest Mouse

The salt marsh harvest mouse was federally listed as endangered in 1970 (Service 1970). Critical habitat has not been proposed or designated. A detailed account of the taxonomy, ecology, and biology of the salt marsh harvest mouse is presented in the *Salt Marsh Harvest Mouse & California Clapper Rail Recovery Plan* (Service 1984) (Recovery Plan) and the references cited therein. The salt marsh harvest mouse is a Fully Protected Species under California law (See California Fish and Game Code Section 4700).

The salt marsh harvest mouse is a rodent endemic to the salt and brackish marshes of the San Francisco Bay Estuary and adjacent tidally influenced areas. The salt marsh harvest mouse closely resembles the western harvest mouse (*R. megalotis*). The salt marsh harvest mouse typically weighs about 0.35 ounce, has a head and body length ranging from 2.7-2.9 inches, a tail length ranging from 2.6-3.2 inches, and a hind foot length of 0.7 inch (Fisler 1965). As stated in the recovery plan, the salt marsh harvest mouse, when compared to the western harvest mouse, have darker ears, belly and back, and a slightly thicker, less pointed and unicolored tail. The salt marsh harvest mouse is further distinguished taxonomically into the northern and southern subspecies, *R. raviventris halicoetes* and *R. raviventris raviventris*, respectively. Of the two subspecies, *R. r. halicoetes* more closely resembles *R. megalotis*, and can be difficult to differentiate in the field; body color and color of ventral hairs as well as the thickness and shape of the tail have been used to distinguish the two.

The salt marsh harvest mouse has evolved to a life in tidal marshes. Specifically, they have evolved to depend mainly on dense pickleweed as their primary cover and food source. However, salt marsh harvest mice may utilize a broader source of food and cover which includes saltgrass (*Distichlis spicata*) and other vegetation typically found in the salt and brackish marshes of this region. In natural systems, salt marsh harvest mice can be found in the middle tidal marsh and upland transition zones. Upland refugia is an essential habitat component during high tide events. Salt marsh harvest mice are highly dependent on cover, and open areas as small as 33 feet wide may act as barriers to movement (Shellhammer 1978, as cited in Service 1984). The salt marsh harvest mouse does not burrow. It has been noted that the northern subspecies may build nests of loose grasses.

As described by Fisler (1965), male salt marsh harvest mice are reproductively active from April through September, but may appear active throughout the year. Females are reproductively active from March to November, and have a mean litter size of approximately four offspring.

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

The preservation and growth of existing populations of the salt marsh harvest mouse is considered important to assuring the survival of this species. The Recovery Plan identifies essential habitat areas to be preserved or restored throughout the Estuary to meet the recovery objectives for this species. No essential habitat for the salt marsh harvest mouse is identified within the action area in the Recovery Plan.

Although no surveys for salt marsh harvest mice have been conducted within the action area, pickleweed-vegetated tidal wetlands and other potential habitat areas of suitable for the salt marsh harvest mouse occur within the action area at the Petaluma Bridge crossing. Salt marsh harvest mice have been detected in tidal marshes approximately 0.5 mile downstream of the Petaluma Bridge portion of the action area. Given that the salt marsh harvest mouse recovery plan identified four essential habitat areas on the Petaluma River and the species is known throughout the Petaluma Marsh Wildlife Area downstream of the Petaluma Bridge it is likely that salt marsh harvest mice would be found in pickleweed habitat throughout the tidally influenced portions of the Petaluma River system. As noted in the May 2008 Biological Assessment, California Department of Fish and Game biologist Fred Botti stated that the listed mouse may use the pickleweed habitat at the Petaluma Bridge crossing for migration or dispersal. Therefore, given the biology and ecology of this animal, the presence of occupied habitat in other nearby tidal marshes, and recent records, the salt marsh harvest mouse is likely to inhabit the action area.

Effects of the Proposed Action

California Red-Legged Frog

The proposed project could have adverse effects on the threatened California red-legged frog through mortality, injury, harassment, and harm of individual juveniles and adults. According to the August 5, 2008, Caltrans letter, the proposed actions will adversely affect 206.94 acres of California red-legged frog habitat. According to Caltrans, the affects amount to 203.78 acres of permanent effects and 3.16 acres of temporary effects associated with the creation of bioswales.

The proposed project likely will result in adverse effects to the feeding, resting, aestivation, movement, and other essential behaviors of the California red-legged frog. It will result in the loss and degradation of habitat. The primary east-west habitat connectivity in Segment B is at the existing bridge spanned creek crossings. The bridge widening at these locations is unlikely to present any barriers to those movement corridors. Construction and maintenance of properly sized and located culverts likely will minimize this adverse effect of the threatened California red-legged frog (see Rodriguez *et al.* 1996; Yanes *et al.* 1905).

Construction activities associated with the proposed project would remove vegetation and other materials necessary for cover and aestivation, fill or crush burrows or crevices, and potentially reduce the prey base for the California red-legged frog. Because this listed amphibian uses small mammal burrows and soil crevices for shelter, individuals may be crushed, buried, or otherwise injured during construction activities. California red-legged frogs also may be run over by construction equipment or other vehicles accessing the construction areas. Disturbance caused by construction activities may cause frogs to disperse into areas of unsuitable habitat, increase the risk of predation or other sources of mortality. Siltation, fill, or spill of petroleum products or other chemicals could cause loss of prey items in or adjacent to the project area. Construction activities are likely to result in the direct disturbance, displacement, injury, and/or morality of California red-legged frogs. Individuals likely are to be killed or injured by construction equipment or other vehicles accessing the construction site. There is a likelihood of direct injury or mortality to the animal from injury or death due to pet cats or dogs owned by construction related personnel, poisoning by pesticides, injury or death due to predators attracted to food or trash at the site, and harassment from night-lighting, noise, and vibration. Implementation of certain types of erosion control materials, such as plastic netting, could result in the entanglement and death of California red-legged frogs within these materials due to exposure or predators (Bartin and Kinkead 2005; Stuart *et al.* 2001). Disturbance from construction activities may also cause individuals to move into or across areas of unsuitable habitat where they may be prone to higher rates of mortality from vehicles and predation.

Range-wide habitat loss, fragmentation, and degradation from multiple factors are the primary threats to the California red-legged frog (Service 1996, 2004). Loss of natural lands continues to occur further reducing the habitat available for this listed animal. However, the amount of historical and current habitat loss directly attributable to road loss has not been calculated, but the effect of habitat fragmentation on the California red-legged frog is significant. Fragmentation can reduce access to habitat as well as habitat suitability, increase mortality of animals that are moving between habitat patches due to increased risk of predation, and disrupt movements, dispersal, and gene flow. As barriers to movement for the California red-legged frog, roads create smaller patches of habitat and increase patch isolation. Smaller populations of animals are at greater risk of extinction by chance from demographic, genetic, and environmental stochastic events (Wilcox and Murphy 1985; Schoener and Spiller 1992). Isolated populations also have a higher chance of extinction without the demographic and genetic input of immigrants and a lower chance of colonization after extinction (Lande 1988; Sjogren-Gulve 1994).

The short term temporal effect will occur when suitable habitat is lost when riparian and other vegetation vegetation is removed for construction of the highway, and also due to the improved ability of predators to hunt the listed amphibian. Hilty and Merender (2004) found that, in contrast to native species, non-native mammalian predators were more active in narrow and denuded riparian corridors and in large expanses of agricultural land (vineyards) far from core habitat. The increased width of the highway along with higher numbers of vehicles and speed of the cars and trucks likely will discourage or prevent movement by the California red-legged frog.

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 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.

Fahrig *et al.* (1995) found that high traffic two-lane paved roads had a much larger effect on frog abundance than low traffic two-lane roads. 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).

State Route 101 from Navato to Petaluma is a formidable barrier to California red-legged frog and general wildlife movement. There are existing bridge and culvert crossings that have the potential to provide wildlife passage under State Route 101. As part of the project, Caltrans plans to upsize the diameter of approximately 36 culvert pipes and one reinforced concrete box (RCB). These replacements will include the installation of two 18-inch pipes, twenty 24-inch

pipes, six 30-inch pipes, one 36-inch pipe, two 42-inch pipes, one 43-inch pipe and a 6 foot by 3 foot RCB. In addition, Caltrans will install approximately 41 new culvert pipes, including one new 7 foot by 7 foot cattle pass. These new structures include five 18-inch pipes, fifteen 24-inch pipes, four 30-inch pipes, three 36-inch pipes, one 42-inch pipe, and two 48-inch double pipes. There are also existing crossing structures in Segment B that are not subject to project alteration. Those include two 7- to 10-foot high cattle crossings and eight 2- to 7-foot high RCBs.

The project will provide more opportunity for wildlife passage under State Route 101, however, it is doubtful if frogs will use long corregated culverts across a 80-foot or wider roadway that are not day-lighted, do not have a natural bottom, and do not have regular maintenance to prevent filling with sediment and debris. The dimension of the tunnels is considered one of the most important variables in the design of passage ways for vertebrates (Yanes *et al.* 1995; Rodriguez *et al.* 1996); although no studies have determined a minimum width for the California red-legged frog, passages made for other small vertebrates, such as salamanders, must be wide and tall enough to enable animals to clearly see to the opposite end of the culvert, or there is lighting along the culvert provided by overhead grates. Ng *et al.* (2004) note that culverts typically are installed to accommodate water flow, the installation of such passage ways solely for listed species and wildlife, especially across major roadways, is justified if no other passages or crossings exist and there is suitable habitat. It is also important that the crossing attract target listed species and wildlife; fencing or other measures be incorporated into a wildlife crossing to guide animals to the preferred crossing; the crossing be placed strategically to enhance habitat connectivity; and that the adjacent land use be conducive to long-term habitat protection (Portland State University 2003). The culverts, RCBs, and cattle crossings proposed by Caltrans may not adequately minimize the reduction or elimination of the movement of the California red-legged frog. The long term viability of any designated wildlife crossing is questionable unless crossing locations and the habitat on both sides of the crossing are permanently set aside as open space or have a conservation easement or some other designation that limits development. In addition, hog wire apparently will not be placed on the bottom one foot of the highway perimeter fence to deter frogs from entering the roadway and guide them towards safe crossings. The culverts may not be high enough to allow the animals to see through them to the other side of the roadway, improper placement in areas where the animals will not use them, and the uncertainty of maintenance and silt removal at drainage-associated crossings could eliminate their potential use by the frogs. The lack of hog wire will result in individuals crossing the roadway where they are more likely to be killed by vehicles.

Larger culverts, e.g. at least 72 inches tall, grates placed midway on the culvert to allow lighting to encourage the animals to use them, placement in areas where the animals are moving through, and appropriate, maintenance and silt removal, and the use of properly sized hog wire along the bottom of the highway perimeter fence to guide the California red-legged frog to the culverts, RCBs, and cattle crossings should increase the potential for these animals to move across the State Route 101 right-of-way in areas other than the bridged creek crossings.

Road studies suggest that properly designed passage can significantly reduce wildlife, including frog mortality (Dodd *et al.* 2004). The Town of Amherst in the State of Massachusetts installed two culverts with guiding fences to facilitate spotted salamander (*Ambystoma maculatum*) migration from their wintering burrows during the spring. Before the placement of these culverts under Henry Street, a two-lane street, salamander mortality was high. After installation, approximately 75.9% of animals that reached the tunnel entrances successfully passed through them (Jackson 1996).

The installation of a concrete median will present a definitive barrier to California red-legged frog movement over the road. Within the concrete medians, Caltrans plans to install Type S barriers for wildlife crossing every 20 feet and Type M wildlife crossings would be installed every 0.25 miles. Type S barriers are a type 60 concrete barrier with a 6 inch diameter opening at the base of the barrier for small animal passage. Type M wildlife crossings are a type 60 concrete barrier with a 2-foot break in the barrier, with the break protected by a thrie-beam guard rail to deflect vehicle traffic. Given the amount of traffic on State Route 101 it is unlikely that frogs will be able to successfully cross the road even if they do manage to find these openings.

Though the intent of wildlife culverts and crossings are to ensure safe passage of listed species and wildlife, they are also a benefit to human safety (Aleshire 2007; Ruediger and DiGiorgio undated; Sherwood 2007). Deer-automobile collisions, estimated by the Insurance Information Institute to occur at a rate of 500,000 per year, result in over $1 billion worth of vehicular damages, 29,000 human injuries, and 200 human fatalities each year (Cornell University). Insurance company, State Farm estimates that there were more than 1.2 million claims for damage in crashes with animals during the last half of 2007 and the first half of 2008 (Highway Loss Data Institute 2008). Although most animal strikes do not result in human injury, human deaths resulting from animal collision is increasing (Highway Loss Data Institute 2008). Culverts large enough to accommodate species such as deer (*Odocoileus* species) and mountain lion (*Felis concolor*), while maintaining substrates for the California red-legged frog and smaller wildlife, could reduce roadway collisions for a variety of species. For example, wildlife crossings of the Trans-Canada Highway in Canada's Banff National Park have reduced wildlife road mortality by 80%, and as much as 96% for ungulates (Robbins 2003).

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 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 top persist in landscapes with low habitat cover. Gibbs (1998) postulated that the land between habitat 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.

The construction activities at the proposed project could result in the introduction of chemical contaminants to the site. Substances used in road building materials or 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. Large spills may be partially or completely mitigated by clean-up efforts, depending on the substance. California red-legged frogs 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 the California red-legged frog. 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.

Preconstruction surveys and the relocation of individual red-legged frogs may reduce injury or mortality. However, the capturing and handling of red-legged frogs to remove them from a work area may result in the harassment, mortality or injury of individuals. Stress, injury, and mortality may occur as a result of improper handling, containment, and transport of individuals. Death and injury of individual red-legged frogs could occur at the time of relocation or later in time subsequent to their release. Although survivorship for translocated red-legged frogs 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. Improper handling, containment, or transport of individuals would be reduced or prevented by use of a Service-approved biologist, by limiting the duration of handling, limited the distance of translocation, and requiring the proper transport.

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 chytrid fungus 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). Implementation of the "Declining Amphibian Populations Task Force Fieldwork Code of Practice" during any aquatic survey activity will likely prevent transfer of diseases through contaminated equipment or clothing.

Construction of roads can facilitate the invasion and establishment by species not native to the area (Gelbard and Belnap 2003) or are native and are better competitors than the California red-legged frog, such as the bullfrog, that could feed on or compete with, the listed amphibian or its food sources. Disturbance and alteration of habitat adjacent to roads 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 road to disperse into California red-legged frog habitat. These animals could compete with the listed ranid for resources such as food or cover, or directly injure or kill the amphibians. Non-native plants and animals may reduce habitat quality for the threatened frog, and reduce the productivity or the local carrying capacity for the animals. Introductions of non-native species could cause California red-legged frogs to alter behavioral patterns by avoiding or abandoning areas near road.

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 they can alter natural communities and potentially affect habitat quality. A problematic species within the range of the California red-legged frog 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* species) and Russian thistle (*Salsola tragus*) (Tellman 1997). Disturbed soils and reduced competition from native plants are some of the conditions that facilitate invasion along roads by non-native plant species.

Negative effects to wildlife populations from roads 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 2790 feet from roads in Texas. They estimated snake abundance out to 2790 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 1640 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 1575 feet-6560 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 1000 feet in woodlands, 1197 feet in grasslands, and 2657 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 red-legged frog have not been adequately investigated.

The proposed compensation for the effects to 203.78 acres of California red-legged frog habitat will likely be beneficial to this listed species in Marin and/or Sonoma Counties. Caltrans proposes expenditure of the funds to purchase California red-legged frog credits at a Service-approved approved conservation bank, establishment of a Service-approved conservation easement, or obtaining fee title to habitat acquisition.

Caltrans is entertaining the possibility of obtaining a conservation easement at the Lawson's Landing property at Dillon Beach in Marin County. Lawson's Landing property is approximately 940 acres, and is one of the few areas remaining in coastal California with an active dune system that is not under permanent conservation status. The site supports a high proportion of dune slack wetlands with breeding habitat for the California red-legged frog. It has the largest expanse of native coastal scrub vegetation on paleodunes north of Monterey. The beach supports one of the largest wintering populations for the threatened western snowy plover (*Charadrius alexandrinus nivosus*) between San Francisco and the northern end of their range in Washington State. The endangered Myrtle's silverspot butterfly (*Speyeria zerene myrtleae*) has been documented in the past as well as the endangered Tidestrom's lupine (*Lupinus tidestromii*) and the potential exists to repatriate these species for their recovery. The dunes and wetlands host numerous other special status plants and invertebrates that are adapted to shifting sands and coastal wetlands. The site not only offers important biological resources, but geological interest, as well as stunning scenic resources. The area contains important habitat for the California red-legged frog, as well as other listed species. Not all of the Lawson's Landing property provides habitat for the California red-legged frog but the establishment of a conservation easement on the California red-legged frog habitat within the Lawson's Landing property likely will provide benefits to several listed species, as well as native wildlife.
There are also several ranchers in Marin and Sonoma Counties that would be willing to sell conservation easements on their land that would allow them to maintain ecologically sustainable grazing while providing in-perpetuity management for the California red-legged frog. Conservation easements would be especially valuable for this listed frog in areas of designated or proposed California red-legged frog critical habitat.

Salt Marsh Harvest Mouse

Construction and other work activities at the Petaluma River Bridge crossing would permanently eliminate about 0.05 acres of pickleweed-vegetated habitat currently available for salt marsh harvest mice. Construction and other work activities in and around the pickleweed habitat near the Petaluma River Bridge crossing could affect individual salt marsh harvest mice through increased disturbance and habitat destruction. Increased levels of disturbance to salt marsh harvest mice would result from noise and vibrations from equipment and other work activities. Operation of equipment and associated loss of habitat would result in displacement of salt marsh harvest mice from protective cover and their territories/home ranges (through noise and vibrations) and/or direct injury or mortality (through crushing). These disturbances likely would disrupt normal behavior patterns of breeding, foraging, sheltering, and dispersal, and likely result in the displacement of salt marsh harvest mice from their territory/home range in the areas where their habitat is destroyed. Displaced salt marsh harvest mice may have to compete for resources in occupied habitat, and may be more vulnerable to predators. Female salt marsh harvest mice are reproductively active from March through November (Fisler 1965), so disturbance during this period could result in abandonment or failure of their litter. Thus, displaced salt marsh harvest mice may suffer from increased predation, competition, mortality, and reduced reproductive success.

Salt marsh harvest mice could be harmed if the habitat area affected by the proposed action is colonized by non-native, invasive plant species. The proposed action could result in the invasion of non-native plant species in the habitat area off the Petaluma River and subsequently into adjacent habitat areas for the salt marsh harvest mouse and California clapper rail. If established in these habitat areas, these non-native plant species could limit the habitat value of these areas for salt marsh harvest mice and California clapper rails by out competing and preventing or limiting the establishment of native wetland plant species. Successful removal of non-native, invasive plant species could prevent, or at least severely reduce the establishment of these undesirable species and ensure that current habitat values are reestablished or increased.

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 continue to negatively affect the California red-legged frog in Marin and Sonoma Counties. Habitats are lost or degraded as a result of road and utility construction and maintenance, overgrazing, agricultural expansion, and water irrigation and storage projects that may not be funded, permitted, or constructed by a Federal agency. Other threats include contamination, poisoning, increased predation, and competition from non-native species associated with human development. Small private actions that may impact listed species, such as conversion of land, small mammal population control, mosquito control, and residential development, may occur without consultation with or authorization by the Service or the California Department of Fish and Game pursuant to their respectively Endangered Species Act.

As urban development continues, it will likely adversely affect upland areas that serve as dispersal and aestivation habitat for red-legged frogs. Continued development and maintenance of roadways to serve expanding urban areas may further fragment and isolate populations of red-legged frogs from other nearby populations. Increased predation associated with domesticated pets or feral animals generally accompanies urban expansion. As urban development encroaches on rural areas, the need increases for mosquito abatement programs that may introduce exotic fish into ponds used for breeding by red-legged frogs, thus impacting the reproductive success of this species.

Increased levels of vehicles and increased vehicle speeds could lead to an increased mortality level for the California red-legged frog. The cumulative local development will result in temporary and permanent habitat fragmentation. The results of fragmentation are inhibition of genetic exchange between populations and impediments to recolonization of habitats from which populations have been extirpated. Small, isolated populations are substantially more vulnerable

to stochastic events (e.g., aberrant weather patterns, fluctuations in availability of food) and may exhibit reduced adaptability to environmental (natural or anthropogenic) changes.

There is a continued demand for new housing and commercial development in Marin and Sonoma Counties and other road and development projects have been recently completed or are planned along the State Route 1, State Route 12, State Route 101, and State Route 116. These developments and further infill will eliminate the habitat connectivity between listed species habitat remaining habitat in the action area vicinity and the local region. Development of adjacent wildlife habitat will continue to result in the loss of not only breeding, resting, and foraging habitat, but the loss of dispersal corridors between breeding populations, thereby further isolating and fragmenting wildlife populations. Additionally, development of small reservoirs or water bodies, such as golf course hazards, and water diversions may occur which may pose further threats such as disruption of dispersal corridors for terrestrial species, and competition or predation from with non-native species such as bullfrogs for aquatic species.

Cumulative effects to the California red-legged frog include continuing and future conversion of suitable breeding, foraging, sheltering, and dispersal habitat resulting from urban development. Additional urbanization can result in road widening and increased traffic on roads that bisect habitat, thereby increasing road-kill while reducing in size and further fragmenting remaining habitats.

Cattle-grazing is a common land use practice in rural Marin and Sonoma Counties. Overgrazing results in degradation and loss of riparian vegetation, increased water temperatures, streambank and upland erosion, and decreased water quality in streams. Livestock operations may also degrade water quality with pesticides and nutrient contamination. However, light to moderate livestock grazing is generally thought to be compatible with continued successful use of rangelands by the red-legged frog and other listed species, provided the grazed areas do not also have intensive burrowing rodent control efforts (T. Jones, in litt. 1993; Shaffer et al. 1993). The shorter vegetation associated with grazed areas may make the habitat more suitable for ground squirrels whose burrows are utilized by red-legged frogs. Rodent control in rural areas in Marin and Sonoma Counties could contribute to the decline of red-legged frogs in the region; as well as other sensitive species that utilize burrows created by burrowing rodents.

Agricultural development, impoundments, and irrigation can reduce stream flows, resulting in the loss of aquatic habitat during the summer for red-legged frogs. Discing is a common practice on agricultural lands which can result in substantial losses of upland habitat for red-legged frogs. Significant conversion of rural, undeveloped land to agricultural land, particularly vineyards, is currently occurring in Sonoma County, resulting in loss of upland habitat for listed species. California red-legged frogs likely are exposed to a variety of pesticides and other chemicals throughout their ranges. This amphibian species could also die from starvation due to the loss of their prey base. Hydrocarbon and other contamination from oil production and road runoff; the application of numerous chemicals for roadside maintenance; urban/suburban landscape maintenance; and rodent and vector control programs may all have negative effects on red-legged

frog populations. In addition, red-legged frogs may be harmed through increased road kill due to the construction and use of new roads and increased traffic in the overall region and collection by amphibian enthusiast and others.

Further habitat fragmentation; additional non-native species introduction; translocation of infected individuals, and increased access to aquatic habitat could facilitate or increase the spread of amphibian diseases within the range of the California red-legged frog. The global mass extinction of amphibians primarily due to chytrid fungus continues to be of significant concern (Norris 2007; Skerratt *et al* 2007).

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 et al. 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. As the global climate warms, terrestrial habitats are moving northward and upward, but in the future, range contractions are more likely than simple northward or upslope shifts. Ongoing global climate change (Anonymous 2007; Inkley et al. 2004; Adger et al. 2007; Kanter 2007) likely imperils the California red-legged frog and the resources necessary for its 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.

Numerous activities continue to eliminate habitats of salt marsh harvest mice. Habitat loss and degradation affecting this species continues as a result of urbanization, freshwater urban run-off, and contaminant inputs. Salt marsh harvest mice are also affected by increased predation associated with human development, and disturbance of breeding and foraging behavior. All of these non-Federal activities are expected to continue to adversely affect listed species considered in this opinion within the action area.

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 FHWA so that they become binding conditions of any grant or permit issued to FHWA as appropriate, in order for the exemption in section 7(o)(2) to apply. FHWA has a continuing duty to regulate the activity covered by this Incidental Take Statement. If FHWA (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

The Service anticipates that incidental take of the California red-legged frog will be difficult to detect because when California red-legged frogs are not in their breeding ponds, they inhabit the burrows of ground squirrels or other rodents; they may be difficult to locate due to their cryptic appearance and behavior; the juvenile and adult animals 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 their relatively small body size. Recent project monitoring suggests that California red-legged frogs are difficult to find during preconstruction clearance surveys that include excavation of potential upland salamander refugia in close proximity to breeding ponds and other aquatic habitat. Losses of California red-legged frogs may also be difficult to quantify due to seasonal fluctuations in their numbers, random environmental events, changes in water regime at their breeding ponds, or additional environmental disturbances. 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 project as all of the California red-legged frogs inhabiting or utilizing the 206.94 acres of habitat identified within Segment B and Washington Creek and Lynch Creek in Segment C. The incidental take is expected to be in the form of harm, harassment, injury, and mortality to adult California red-legged frogs from habitat loss/degradation, construction-related disturbance, and capture and relocation.

The Service anticipates incidental take of the salt marsh harvest mouse will be difficult to detect or quantify because of the variable, unknown size of any resident population over time, and the difficulty of finding killed or injured small mammals. The level of take of salt marsh harvest mice can be anticipated by the loss of available habitat. The Service considers the number of salt marsh harvest mice subject to harassment from noise and vibrations to be impracticable to estimate. Upon implementation of the Reasonable and Prudent Measures, incidental take associated with the proposed project in the form of harm, and harassment of the salt marsh harvest mouse caused by habitat loss and construction activities will become exempt from the prohibitions described under section 9 of the Act.

Upon implementation of the following reasonable and prudent measures incidental take associated with the proposed action described above for the California red-legged frog and salt marsh harvest mouse will become exempt from the prohibitions described under section 9 of the Act.

Effect of the Take

The Service determined that this level of anticipated take is not likely to result in jeopardy to the California red-legged frog or the salt marsh harvest mouse. There is no designated or proposed critical habitat for the listed frog in the action area and critical habitat has not been designated for the salt marsh harvest mouse.

Reasonable and Prudent Measures

The following reasonable and prudent measures are necessary and appropriate to minimize the effect of the proposed action on the California red-legged frog and the salt marsh harvest mouse. FHWA will be responsible for compliance with these measures which they will entrust Caltrans to implement:

1. FHWA will ensure the conservation measures in the project description as described in the May 2008, Biological Assessment, the August 27, 2008 revised project description, and this biological opinion will be implemented.

2. FHWA will ensure adverse effects to the California red-legged frog and the salt marsh harvest mouse will be minimized.

3. FHWA will ensure their compliance with this biological opinion.

Terms and Conditions

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

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

   a. FHWA shall minimize the potential for harm, harassment, or killing of federally listed wildlife species resulting from project related activities by implementation of the conservation measures as described in the May 2008, Biological Assessment, the August 27, 2008 revised project description, and appearing in the *Project Description* of this biological opinion.

   b. FHWA/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. In addition, Caltrans shall educate and inform contractors involved in the project as to the requirements of the biological opinion.

   c. Caltrans and FHWA have proposed to provide 1:1 compensation for the effects to 203.78 acres of California red-legged frog habitat. Acceptable compensation shall be satisfied through in-perpetuity preservation of high quality red-legged frog habitat consisting of a breeding and/or significant dispersal habitat between breeding populations or a biological equivalent site similar to Lawson's Landing through

purchase of bank credits and/or acquisition of a conservation easement or fee title. Purchase of the site shall be reviewed and approved by the Service.

If a compensation bank is proposed in lieu of acquisition it shall be a Service-approved bank.

An approved ecologically-based conservation easement shall include restricted public access, a management plan, and an in-perpetuity endowment or other permanent non-wasting management fund based on a property analysis. The management plan shall include a description of the site, management needs (e.g. grazing plan, non-native vegetation and animal control, etc), when the management activities should be implemented, how often and to what level monitoring of the site shall occur, and a action/contingency plan to address potential management issues.

Proposed habitat acquisition shall also be accompanied by a Service-approved conservation easement that shall include restricted public access, a management plan, and an in-perpetuity endowment based on a property analysis.

Caltrans will demonstrate measurable progress in proving the Service approved compensation prior to initiating construction in Segment B in Phase 1, not no later than initiating construction on Phase 2.

d. Wildlife crossings established in Segment B shall be reviewed and approved by the Service.

e. FHWA/Caltrans shall prepare a relocation plan for moving California red-legged frogs that will be submitted to the Service for review and approval at least thirty (30) calendar days prior to the date of groundbreaking.

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 project. The Resident Engineer or their designee shall maintain a copy of this biological opinion onsite whenever construction is taking place. Their name and telephone number shall be provided to the Service at least thirty (30) calendar days prior to groundbreaking at the project. Prior to ground breaking, the Resident Engineer must submit a letter to the Service verifying that they posses a copy of this biological opinion and have read the Terms and Conditions.

b. The Caltrans biologist shall have oversight over implementation of all the Terms and Conditions in this biological opinion, and shall have the authority to stop project

activities, through communication with the Resident Engineer or their designee, if any of the requirements associated with these Terms and Conditions are not being fulfilled. If biologist/construction liaison has requested a stop work due to take of any of the listed species the Service and the California Department of Fish and Game will be notified within one (1) working day via email or telephone.

c. Only Service-approved biologist(s) who are familiar with the biology and ecology of the California red-legged frog shall capture or handle this listed species.

d. To control erosion during and after implementation of the project, the applicant will implement erosion control BMPs. Erosion control measures and BMPs, which retain soil or sediment, runoff from dust control, and hazardous materials on the construction site and prevent these from entering aquatic habitat, will be placed, monitored, and maintained throughout the construction operations. These measures and BMPs may include, but are not limited to, silt fencing, sterile hay bales, vegetative strips, hydroseeding, and temporary sediment disposal.

e. Nets or bare hands may be used to capture California red-legged frogs. Service-approved biologists will not use soaps, oils, creams, lotions, repellents, or solvents of any sort on their hands within two hours before and during periods when they are capturing and relocating red-legged frogs. To avoid transferring disease or pathogens between aquatic habitats during the course of surveys or handling of red-legged frogs, Service-approved biologists will follow the Declining Amphibian Populations Task Force's "Code of Practice." Service-approved biologists will limit the duration of handling and captivity of red-legged frogs. While in captivity, individual frogs shall be kept in a cool, moist, aerated environment, such as a bucket containing a damp sponge. Containers used for holding or transporting adults shall not contain any standing water. California red-legged frogs should not be moved outside their functional population in order to reduce translocation stress and the spread of disease.

f. Biologists shall take precautions to prevent introduction of amphibian diseases to the action area by disinfecting equipment and clothing as directed in the October 2003, California tiger salamander survey protocol titled, Interim Guidance on Site Assessment and Field Surveys for Determining Presence or a Negative Finding of the California Tiger Salamander and the recommended equipment decontamination procedures within the Service's California Red-Legged Frog Survey Guidance. Both items are available at the Service's Sacramento office website (http://www.fws.gov/sacramento/es/protocol.htm). Disinfecting equipment and clothing is especially important when biologists are coming to the action area to handle salamanders or frogs after working in other aquatic habitats.

g. All California red-legged frogs encountered in the action area should be relocated to a Service-approved location. The relocation site must be approved for the Marin Sonoma Narrows Project prior to ground breaking.

h. An outline of the employee environmental awareness program shall be submitted to the Deputy Assistant Field Supervisor of the Endangered Species Program at the Sacramento Fish and Wildlife Office within twenty (20) working days prior to the start of construction. Documentation of the training, including individual signed affidavits, will be kept of file and available on request.

i. Permanent and temporary disturbances and other types of project-related disturbance to the habitats of the California red-legged frog and the salt marsh harvest mouse shall be minimized to the maximum extent practicable by Caltrans. To minimize temporary disturbances, all project-related vehicle traffic shall be restricted to established roads, construction areas, and other designated areas. These areas also should be included in pre-construction surveys and, to the maximum extent possible, should be established in locations disturbed by previous activities to prevent further adverse effects.

j. Areas disturbed by project activities will be recontoured to pre-project conditions and reseeded with an appropriate erosion-control mixture. The seed mixture will include appropriate native grasses and forbs. Areas that will be subjected to ongoing maintenance are not areas of temporary effects even if they are restored within one year following the initial disturbance.

k. Construction activities shall not occur adjacent to the pickleweed wetland on the north side of the Petaluma River during high tide events of eight feet or greater (as determined by NAVD88 vertical datum) when salt marsh harvest mice might seek refuge outside of the adjacent inundated tidal marsh. Activities shall not resume until the water level has dropped below the eight foot NAVD88 elevation.

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

a. The following shall be implemented for staging, storage sites, vehicle parking, and access associated with the project:

1. 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 and conducted within the action area.

2. If a staging, storage, access, or vehicle parking area that is in compliance with the Act is not available, the agency with jurisdiction and the contractor would be responsible for compliance with the Act.

c. 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 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 (916) 414-6600, and Resident Agent-in-Charge Dan Crum of the Service's Law Enforcement Division at (916) 414-6660.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities that can be implemented to further the purposes of the Act, such as preservation of endangered species habitat, implementation of recovery actions, or development of information and data bases.

The Service requests notification of the implementation of any conservation recommendations in order to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats. We propose the following conservation recommendations:

1. FHWA, Caltrans, Transportation Authority of Marin, and Sonoma County Transportation Authority should assist the Service in implementing recovery actions identified in the *Recovery Plan for the California Red-legged Frog* (Service 2002).

2. Caltrans should consider participating in the planning for a regional habitat conservation plan for the California red-legged frog, salt marsh harvest mouse, other listed species, and sensitive species.

3. FHWA, Caltrans, Transportation Authority of Marin, and Sonoma County Transportation Authority should consider establishing functioning preservation and creation conservation banking systems to further the conservation of the California red-legged frog, salt marsh harvest mouse, and other listed species. Such banking systems also could possibly be utilized for other required mitigation (i.e., seasonal wetlands, riparian habitats, etc.) where

appropriate. Efforts should be made to preserve habitat along roadways in association with wildlife crossings.

4. Roadways can constitute a major barrier to critical wildlife movement. Therefore, FHWA, Caltans, Transportation Authority of Marin, and Sonoma County Transportation Authority should incorporate culverts, tunnels, or bridges on highways and other roadways that allow safe passage by California red-legged frog, other listed animals, and wildlife. Photographs, plans, and other information in to the biological assessments if "wildlife friendly" crossings are incorporated into projects. Efforts should be made to establish upland culverts designed specifically for wildlife movement rather than accommodations for hydrology. Transportation agencies should also acknowledge the value of enhancing human safety by providing safe passage for wildlife in their early project design.

5. FHWA and Caltrans should continue to pursue multifaceted compensation packages such as the one developed for the proposed U.S. Interstate 580/Isabel Avenue Interchange Construction Project on future formal consultations with the Service.

6. Caltrans should continue to develop and implement their Early Statewide Biological Mitigation Planning Project that has been developed by the University of California at Davis, Road Ecology Center through Caltrans funding.

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 State Route 101 Marin-Sonoma Narrows HOV Widening Project, Marin and Sonoma Counties, 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 final project design exceeds the described action area in the May 2008 Biological Assessment; (2) the amount or extent of incidental take is exceeded; (3) 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; (4) 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 (5) 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 State Route 101 Marin-Sonoma Narrows HOV Widening Project, Marin and Sonoma Counties, California, please contact John Cleckler or Ryan Olah at the letterhead address or at (916) 414-6600.

Sincerely,

for Susan K. Moore
Field Supervisor

cc:
Larry Vinzant, Cesar Perez, Federal Highway Administration, Sacramento, California
Dale Jones, California Department of Transportation, Sacramento, California
Jim Richards, John Yeakel, Kevin Melanephy, California Department of Transportation, Oakland, California
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Guy Preston, Preston Engineering Management Consulting, Ashland, Oregon
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John Maitland, Seana Gause, Sonoma County Transportation Authority, Santa Rosa, California

Literature Cited

Adger, N., P.Aggarwal, S. Agrawala, J.Alcamo, A. Allali, O. Anisimov, N. Arnell, M. Boko, O.Canziani, T. Carter, G. Cassa, U. Confalonieri, R. Cruz, E.de Alba Alcaraz, W. Eastreling, C. Field, A. Fischlin, B. Fitzharris, C.G. Garcia, C. Hanson, H. Harasawa, K. Hennessy, S.Huq, R. Jones, L. K. Bogataj, D. Karoly, R. Kliein, Z. Kundzewicz, M. Lal, R. Lasco, G. Love, X. Lu, G. Magrin, L.J. Mata, R. McLean, B. Menne, G. Midgley, N. Mimura, M.Q. Mirza, J. Moreno, L. Mortsch, I. Niang-Diop, R. Nichols, B. Novaky, L. Nurse, A. Nyon, M. Oppenheimer, J. Palutikof, M. Parry, A. Patwardhan, P. R. Lankao, C. Rosenzweig, S. Schneider, S. Semenov, J. Smith, J. Stone, J van Ypersele, D. Vaughan, C. Vogel, T. Wilbanks, P.Wong, S. Wu, and G. Yohe. 2007. Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report. Climate Change 2007: Climate change impacts, adaptation and vulnerability. Brussels, Belgium.

Aleshire, P. 2007. Safe Crossing. High Country News November 12, 2007.

Anonymous. 2007. Global warming is changing the World. Science 316:188-190.

Buechner, M. 1987. Conservation in insular parks: simulation models of factors affecting the movement of animals across park boundaries. Biological Conservation 41:57-76.

Bulger, J. B., N. J. Scott Jr., and R. B. Seymour. 2003. Terrestrial activity and conservation of adult California red-legged frogs *Rana aurora draytonii* in coastal forests and grasslands. Biological Conservation 110:85-95.

California Department of Transportation (Caltrans). 2007. Biological assessment for the restoration of the hydraulic capacity of the Cowan Storm Drain Canal within the U.S. Highway 101/Millbrae Avenue Interchange. EA 3A0400. December 2007. Caltrans District 4, Oakland, California.

California Climate Action Team. 2006. Climate Action Team Final Report to the Governor and Legislature. http://www.climatechange.ca.gov/climate_action_team/index.html.

Cayan, D.A., L. Leurs, M. Hanemann, G. Franco, and B. Croes. 2006. Sceanrios of climate change in California: an overview. A report from the California Climate Change Center, California Energy Commission and the California Environmental Protection Agency, Sacramento, California.

Carr, L.W., and L. Fahrig. 2001. Effect of road traffic on two amphibian species of differing vagility. Conservation Biology 15: 1071-1078.

Casagrandi, R., and M. Gatto. 1999. A mesoscale approach to extinction in fragmented habitats. Nature 400: 560-562.

Cornell University. Management of Wildlife Damage in Suburban and Rural Landscapes. http://wildlifecontrol.info/ne1005. Accessed December 2007.

Dodd, C. K. Jr., W. J. Barichivich, and L. L. Smith. 2004. Effectiveness of a barrier wall and culverts in reducing wildlife mortality on a heavily traveled highway in Florida. Biological Conservation 118 (2004) 619-631.

Drews, C. 1995. Road kills of animals by public traffic in Mikumi National Park, Tanzania, with notes on baboon mortality. African Journal of Ecology 33: 89-100.

Emlen, S. T. 1977. "Double clutching" and its possible significance in the bullfrog. Copeia 1977(4):749-751.

Fahrig, L. 1998, When does fragmentation of breeding habitat affect population survival? Ecological Modeling 105: 273-292.

Fahrig, L., and G. Merriam. 1985. Habitat patch connectivity and population survival. Ecology 66:1762-1768

Fahrig, L., J.H. Pedlar, S.E. Pope, P.D. Taylor, and J. F. Wegner. 1995. Effect of road traffic on amphibian density. Biological Conservation 73: 177-182.

Fellers, G. 2005. *Rana draytonii* Baird and Girard, 1852b California red-legged frog. Pages 552-554 *in* M. Lannoo (editor). Amphibian declines the conservation status of United States species. University of California Press. Berkeley, California.

Fellers, G. M. and P. M. Kleeman. 2007. California Red-Legged Frog (*Rana draytonii*) movement and habitat use: implications for conservation. Journal of Herpetology 41(2): 271-281

Findlay, C.S. and J. Houlahan. 1997. Anthropogenic correlates of species richness in southeastern Ontario wetlands. Conservation Biology 11: 1000-1009.

Fisler, G. F. 1965. Adaption and speciation in harvest mice of the marshes of San Francisco Bay. Univ. Calif. Publ. Zool. 77:1-108.

Forman, R. T., L.E. Alexander. 1998. Roads and their major ecological effects. Annual Review of Ecology and Systematics 29:207-231.

Gibbs, J.P. 1998. Amphibian movements in response to forest edges, roads, and streambeds in southern New England. Journal of Wildlife Management 62: 584-589.

Goals Project. 1999. Baylands ecosystem habitat goals. A report of habitat recommendations prepared by the San Francisco Bay Area Wetlands Ecosystem Goals Project. U.S. Environmental Protection Agency, San Francisco, California, and San Francisco Bay Regional Water Quality Control Board, Oakland, California. 209 pp. plus appendices.

Hanski, I. 1982. Dynamics of regional distribution: the core and satellite hypothesis. Oikos 38:210-221.

_____ 1991. Single species metapopulation systematics: concepts, models and observations. Biological Journal of the Linnean Society 42:3-16.

_____ 1994. A practical model of metapopulation dynamics. Journal of Animal Ecology 63: 151-162.

Hayes, M. P., and M. R. Jennings. 1988. Habitat correlates of distribution of the California red-legged frog (*Rana aurora draytonii*) and the foothill yellow-legged frog (*Rana boylii*): implications for management. Pages 144-158 *in* R. Sarzo, K. E. Severson, and D. R. Patton (technical coordinators). Proceedings of the symposium on the management of amphibians, reptiles, and small mammals in North America. United States Department of Agriculture, Forest Service, Rocky Mountain Range and Experiment Station, Fort Collins, Colorado. General Technical Report (RM-166): 1-458.

Hayes, M. P. and D. M. Krempels. 1986. Vocal sac variation among frogs of the genus *Rana* from western North America. Copeia 1986(4):927-936.

Hayes, M. P. and M. M. Miyamoto. 1984. Biochemical, behavioral and body size differences between *Rana aurora aurora* and *R. a. draytonii*. Copeia 1984(4):1018-1022.

Hayes, M. P., and M. R. Tennant. 1985. Diet and feeding behavior of the California red-legged frog, *Rana aurora draytonii* (Ranidae). Southwestern Naturalist 30(4): 601-605.

Hels, T. and E. Buchwald. 2001. The effect of road kills on amphibian populations. Biological Conservation 99: 331-340.

Highway Loss Data Institute. 2008. Collisions with deer and other animals spike in November; fatal crashes up 50% since 2000. October 30, 2008, news release. Available at http://www.iihs.org/news/2008/iihs_news_103008.pdf.

IFPC. 2001. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change

[Houghton, J.T., Y. Ding, D.J. Griggs, M. Noguer, P.J. van der Linden, X. Dai, K. Maskell, and C.A. Johnson (editors)]. Cambridge University Press, Cambridge, United Kingdom and New York, New York. 881 pp. Available at http://www.ipcc.ch/.

_____ 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Alley, R., T. Berntsen, N.L. Bindoff, Z. Chen, A. Chidthaisong, P. Friedlingstein, J. Gregory, G. Hegerl, M. Heimann, B. Hewitson, B. Hoskins, F. Joos, J. Jouzel, V. Kattsov, U. Lohmann, M. Manning, T. Matsuno, M. Molina, N. Nicholls, J. Overpeck, D. Qin, G. Raga, V. Ramaswamy, J. Ren, M. Rusticucci, S. Solomon, R. Somerville, T.F. Stocker, P. Stott, R.F. Stouffer, P. Whetton, R.A. Wood, D. Wratt. 21 pp. Available at http://www.ipcc.ch/.

Ingles, L.G. 1932a. Four new species of *Heamatoloechus* (Trematoda) from California. University of California Publications in Zoology 37: 189-201.

_____ 1932b. *Cephalogonimus brevicirrus*, a new species of trematoda from the intestine of *Rana aurora* from California. University of California Publications in Zoology 37:203-210.

_____ 1933. Studies on the structure and life history of *Ostiolum oxyorchis* (Ingles) from the California red-legged frog *Rana aurora draytonii*. University of California Publication in Zoology 39:135-162.

Inkley, D.B., M.G. Anderson, A.R. Blaustein, V.R. Burkett, B. Felzer, B. Griffin, J. Price, and T.L. Root. 2004. Global climate change and wildlife in North America. Wildlife Society Technical Review 04-2.

Jackson, S.D. 1996. Underpass systems for amphibians. 4 pages. In G.L. Evink, P. Garrett, D. Zeigler and J. Berry (editors) Trends in Addressing Transportation Related Wildlife Mortality, proceedings of the transportation related wildlife mortality seminar. State of Florida Department of Transportation, Tallahassee, Florida. FL-ER-58-96.

Jennings, M. R. 1988. Natural history and decline of native ranids in California. Pages 61-72 *in* H. F. De Lisle, P. R. Brown, B. Kaufman, and B. McGurty (editors). Proceedings of the Conference On California Herpetology. Southwestern Herpetologists Society, Special Publication 4:1-143.

Jennings, M. R., and M. P. Hayes. 1985. Pre-1900 overharvest of California red-legged frogs (*Rana aurora draytonii*): The inducement for bullfrog (*Rana catesbeiana*) introduction. Herpetological Review 31(1):94-103.

_____ 1990. Final report of the status of the California red-legged frog (*Rana aurora draytonii*) in the Pescadero Marsh Natural Preserve. Final report prepared for the California Department of Parks and Recreation, Sacramento, California, through Agreement (4-823-9018). Department of Herpetology, California Academy of Sciences, Golden Gate Park, San Francisco, California. 30 pages.

Jennings, M. R., M. P. Hayes, and D. C. Holland. 1992. A petition to the U.S. Fish and Wildlife Service to place the California red-legged frog (*Rana aurora draytonii*) and the western pond turtle (*Clemmys marmorata*) on the list of endangered and threatened wildlife and plants. 21 pages.

Kanter, J. 2007. Scientists detail climate changes, Poles to Tropics. New York Times. April 10, 2007.

Kruse, K. C. and M. G. Francis. 1977. A predation deterrent in larvae of the bullfrog, *Rana catesbeiana*. Transactions of the American Fisheries Society 106(3):248-252.

Kupferberg, S. J. 1996a. Hydrologic and geomorphic factors affecting conservation of a river-breeding frog (*Rana boylii*). Ecological Applications 6: 1322-1344.

_____ 1996b. The ecology of native tadpoles (*Rana boylii* and *Hyla regilla*) and the impacts of invading bullfrogs (*Rana catesbeiana*) in a northern California river. PhD dissertation. University of California, Berkeley, California.

Lenihan, J. M., R. Drapek, D. Bachelet, R. P. Neilson. 2003. Climate Change Effects on Vegetation Distribution, Carbon, and Fire in California. Ecological Applications 13(6): 1667-1681.

Lindenmayer, D.B., and H.P. Possingham. 1996. Modeling the interrelationships between habitat patchiness, dispersal capability and metapopulation persistence of the endangered species, Leadbeater's possum, in southeastern Australia. Landscape Ecology 11:79-105.

Mao, J., D. E. Green, G. M. Fellers, and V. G. Chincar. 1999. Molecular characterization of iridoviruses isolated from sympatric amphibians and fish. Virus Research 6: 45-52.

Mallick, S.A., G.J. Hocking, and M.M. Driessen. 1998. Road-kills of the eastern barred bandicoot (*Perameles gunnii*) in Tasmania: an index of abundance. Wildlife Research 25: 139-145.

Munguira, M.L. and J.A. Thomas. 1992. Use of road verges by butterfly and moth populations, and the effect of roads on adult dispersal and mortality. Journal of Applied Ecology 29: 316-329.

Ng, S.J., J.W. Dole, R.M. Savajot, S.R.D. Riley, and T.J. Valone. 2004. Use of highway undercrossings by wildlife in southern California. Biological Conservation 115: 499-507.

Portland State University. 2003. Wildlife crossing, rethinking road design to improve safety and reconnect habitat. Prepared for Metro. Portland State University Planning Workshop. June 2003.

Robbins, E. 2003. No more road kill: What it takes to make highways friendly to animals. Planning 69(2): 33-34.

Rodriguez, A., G. Crema, and M. Delibes. 1996. Use of non-wildlife passages across a high speed railway by terrestrial vertebrates. Journal of Applied Ecology 33: 1527-1540.

Rosen, P.C. and C.H. Lowe. 1994. Highway mortality of snakes in the Sonoran desert of southern Arizona. Biological Conservation 68: 143-148.

Rothermel, R.B. and R. D. Semlitsch. 2002. An experimental investigation of landscape resistance of forest versus old-field habitats to emigrating juvenile amphibians. Conservation Biology 16: 1324-1332.

Rubbo, M.J., and J.M. Kiesecker. 2005. Amphibian breeding distribution in an urbanized landscape. Conservation Biology 19: 504-511.

Ruediger, B., and M. DiGiorgio. Undated. Safe passage. A user's guide to developing effective highway crossings for carnivores and other wildlife. Southern Rockies Ecosystem Project.

Saunders, S., C. Montgomery, and T. Easley. 2008. Hotter and drier: The West's changing climate. The Rocky Mountain Climate Ortganization, and Natural Resources Defense Council. New York, New York.

Schoener, T.W. and D. A. Spiller. 1992. Is extinction rate related to temporal variability in population size? An empirical answer for orb spiders. The American Naturalist 139: 1176-1207.

Sherwood, A. 2007. As cars hit more animals on roads, toll rises. New York Times December 22, 2007.

Sjogren-Gulve, P. 1994. Distribution and extinction patterns within a northern metapopulation of the pool frog, *Rana lessonae*. Ecology 75: 1357-1367.

Stebbins, R. C. 2003. A field guide to western reptiles and amphibians. Houghton Mifflin Company, Boston, Massachusetts.

Storer, T. I. 1925. A synopsis of the amphibia of California. University of California Publications in Zoology 27:1-1-342.

_____ 1933. Frogs and their commercial use. California Department of Fish and Game 19(3)203-213.

Stuart, J. M., M. L. Watson, T. L. Brown, and C. Eustice. 2001. Plastic netting: an entanglement hazard to snakes and other wildlife. Herpetological Review 32(3): 162-164.

Twedt, B. 1993. A comparative ecology of *Rana aurora* Baird and Girard and *Rana catesbeiana* Shaw at Freshwater Lagoon, Humboldt County, California. Unpublished. Master of Science thesis. Humboldt State University, Arcata, California. 53 pages plus appendix.

U.S. Fish and Wildlife Service (Service). 1970. United States List of Endangered Native Fish and Wildlife. October 13, 1970. Fed. Reg. 35(199): 16047-16048

_____ 1984. Salt Marsh Harvest Mouse and California Clapper Rail Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon. 141 pages.

_____ 1996. Endangered and threatened wildlife and plants; determination of threatened status for the California red-legged frog. **Federal Register** 61:25813-25833.

_____ 2002. Recovery plan for the California red-legged frog (*Rana aurora draytonii*). Portland, Oregon. 173 pages.

_____ 2004. Endangered and threatened wildlife and plants; proposed designation of critical habitat for the California red-legged frog (*Rana aurora draytonii*), proposed rule. **Federal Register** 69:19620-19642.

Van der Zande, A.N., W.J. ter Keurs, and W.J. Van der Weijden.. 1980. The impact of roads on the densities of four bird species in an open field habitat - evidence of a long-distance effect. Biological Conservation 18: 299-321.

Van Gelder, J.J. 1973. A quantitative approach to the mortality resulting from traffic in a population of *Bufo bufo* L. Oecologia 13:93-95.

Verboom, B., J., K. Lankester, and J.A. Metz. 1991. Linking local and regional dynamics in stochastic metapopulation models. Biological Journal Linnean Society 42:39-55.

Vos, C.C. and J.P. Chardon. 1998. Effects of habitat fragmentation and road density on the distribution pattern of the moor frog, *Rana arvalis*. Journal of Applied Ecology 35: 44-56.

Vos, C.C. and A.H.P. Stumpel. 1995. Comparison of habitat-isolation parameters in relation to fragmentation distribution patterns in the tree frog (*Hyla arborea*). Landscape Ecology 11: 203-214.

Wilcox, B.A. and D.D. Murphy. 1985. Conservation strategy: the effects of fragmentation on extinction. The American Naturalist 125: 879-887.

With, K.A. and T. O. Crist. 1995. Critical thresholds in species' responses to landscape structure. Ecology 76: 2246-2459.

Wright, A. H. and A. A. Wright. 1949. Handbook of frogs and toads of the United States and Canada. Comstock Publishing Company, Inc., Ithaca, New York. 640 pages.

Yanes, M., J.M. Velasco, and Francisco Suarez. 1995. Permeability of roads and railways to vertebrates: the importance of culverts. Biological Conservation 71: 217-222.