Appendix A –

USFWS Coordination Act Report

United States Department of the Interior

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

In reply refer to:

Mr. Scott Clark
Chief, Planning Division
Corps of Engineers, Sacramento District
1325 J Street
Sacramento, California 95825-2922

Dear Mr. Clark:

The Corps of Engineers has requested supplemental coordination under the Fish and Wildlife Coordination Act (FWCA) for the Folsom Bridge Project, California, as part of the American River Watershed Investigation Long-Term Evaluation. The enclosed report constitutes the Fish and Wildlife Service's Revised Draft Supplemental FWCA report for the proposed project.

If you have any questions regarding this report on the proposed project, please contact Doug Weinrich at (916) 414-6563.

Sincerely,

David L. Harlow
Acting Field Supervisor

Enclosure

TAKE PRIDE IN AMERICA

cc:
CNO, Sacramento, CA
NOAA Fisheries, Sacramento, CA
Regional Manager, Region II, CDFG, Rancho Cordova, CA
Jane Rinck, COE, Sacramento, CA

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

REVISED SUPPLEMENTAL
FISH AND WILDIFE COORDINATION ACT REPORT

FOR THE

AMERICAN RIVER WATERSHED INVESTIGATION FOLSOM DAM MODIFICATION PROJECT

Prepared by

U.S. FISH AND WILDLIFE SERVICE
HABITAT CONSERVATION DIVISION
SACRAMENTO FISH AND WILDLIFE OFFICE
SACRAMENTO, CALIFORNIA

Prepared for

U.S. ARMY CORPS OF ENGINEERS
SACRAMENTO DISTRICT
SACRAMENTO, CALIFORNIA

March 2006

SUPPLEMENTAL
FISH AND WILDLIFE COORDINATION ACT REPORT
AMERICAN RIVER WATERSHED INVESTIGATION, CALIFORNIA
FOLSOM BRIDGE PROJECT
MARCH 2006

BACKGROUND

The Folsom Bridge Project is part of the Folsom Dam Raise Project, which is a component of the Corps of Engineers' (Corps) American River Watershed Long-Term Project. The final Supplemental Plan Formulation Report/Environmental Impact Statement/ Environmental Impact Report (SEIS/EIR) for the Long-Term Project was completed in February 2002. The subsequent Chief of Engineers' Report was forwarded to Congress for possible authorization for construction.

The Folsom Dam Raise Project includes various features to address the Sacramento area's potential flood risk. The main feature of the project is to raise Folsom Dam up to 10 feet to increase the flood storage capacity behind the dam. Construction of the Dam Raise Project (concurrent with construction of the Folsom Dam Modifications Project) is expected to take place over 20 years. Since numerous closures of the existing Folsom Dam Road would be expected during construction, a temporary bridge was proposed to mitigate the effects of these closures.

In February 2003, the U.S. Bureau of Reclamation (Reclamation) closed Folsom Dam Road indefinitely for security and public safety reasons. This closure had significant effects on the residents and businesses in the surrounding area. In September 2004, Congress authorized the Folsom Dam Raise Project, including authorization of construction of a permanent bridge just downstream of Folsom Dam.

The Folsom Dam Bridge Project was authorized by Congress in the Energy and Water Development Appropriations Act of 2004 (Public Law 108-137):

> The Secretary is authorized to accept funds from State and local governments and other Federal agencies for the purpose of constructing a permanent bridge instead of the temporary bridge described in the recommended plan....
>
> The Secretary, in cooperation with appropriate non-Federal interests, shall immediately commence appropriate studies for, and the design of, a permanent bridge (including an evaluation of potential impacts of bridge construction on traffic patterns and identification of alternatives for mitigating such impacts) and.... shall proceed to construction of the bridge as soon as practicable....

The study authority for the American River Watershed Investigation was provided under the Flood Control Act of 1962 (Public Law 87-874), and specific direction was provided in section 566 of the Water Resources Development Act of 1999 (Public Law 106-53).

In the Energy and Water Appropriations Act of 2006 (Public Law 109-103) Congress directed the Corps and Reclamation to work together to reduce flood damages and address dam safety at Folsom Dam. This effort, termed the Combined Federal Project, is a joint effort to address objectives associated with both the Corps' flood damage reduction mission and Reclamation's dam safety program at Folsom Dam and its associated structures. Therefore, concurrent with the Corps' bridge construction project, the Combined Federal Project will evaluate and consider issues associated with the current hydrologic conditions and major flood events, seismic conditions, and static conditions including seepage and piping through the embankments. An initial screening of measures which could be undertaken as part of this effort included construction of an auxiliary spillway on the left abutment of Folsom Dam. As a result, the bridge project assumed a spillway would be built and included it in design of the bridge project.

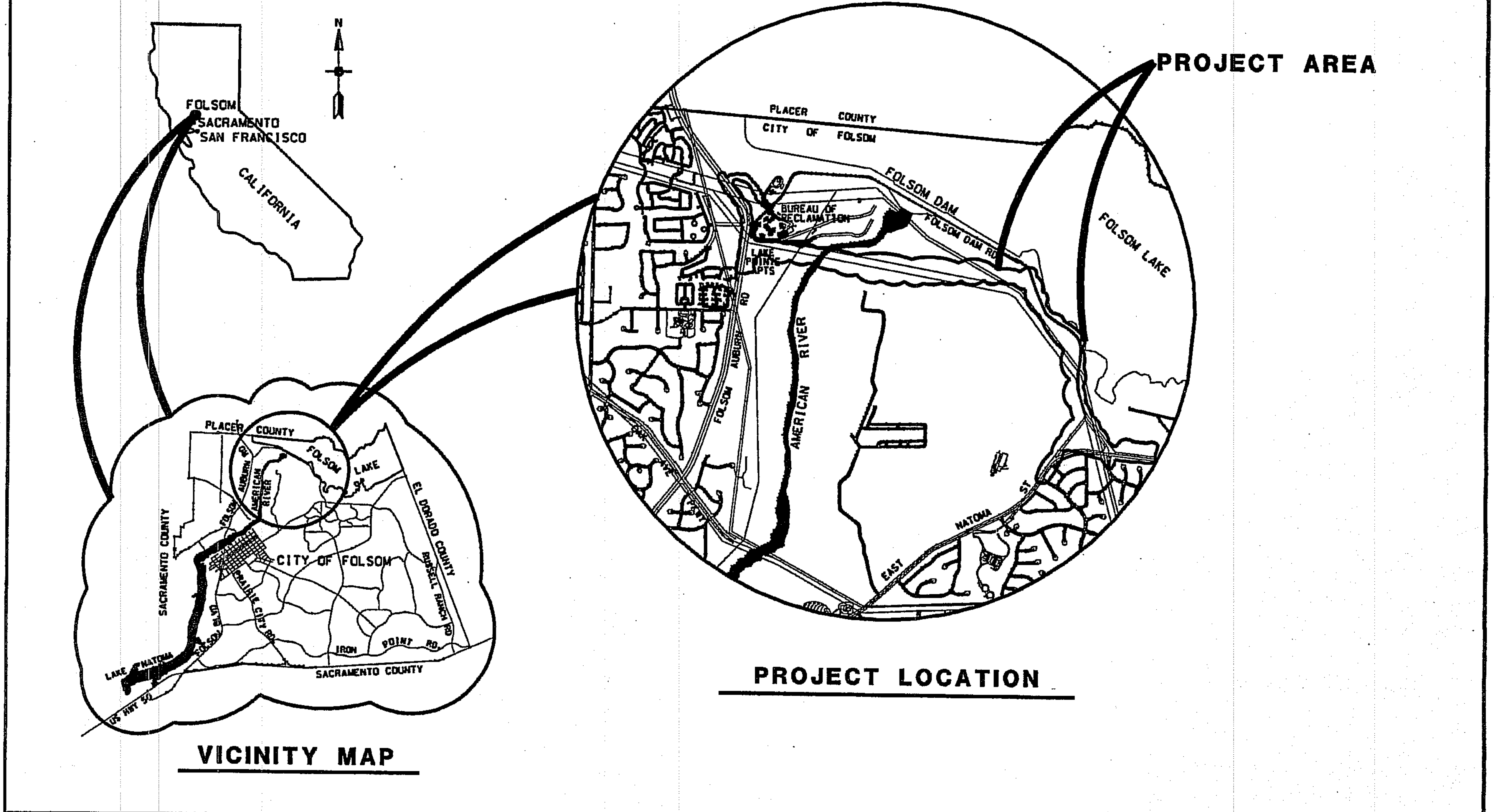
PROJECT DESCRIPTION

The project is located in northeastern Sacramento County, near the City of Folsom, California (Figure 1). The project area is shown outlined in black on Figure 2. A general road alignment of the alternatives being evaluated by the Corps for the Folsom Bridge Project is shown in Figures 3 and 4.

The alternatives are:

Alternative 1 - No Action
Alternative 2 - Four-Lane Bridge, Four-Lane Road, Full Intersections
Alternative 3 - Four-Lane Bridge, Two-Lane Road, Full Intersections
Alternative 4 - Four-Lane Bridge, Two-Lane Road, Partial Intersection (East)
Alternative 5 - Four-Lane Bridge, Two-Lane Road, Two Partial Intersections

Each action alternative would provide a full traffic arterial between the existing Folsom Dam Road intersection at East Natoma Street to the Folsom-Auburn Road with a bridge crossing at the American River in the vicinity of Folsom Dam. Each alternative would be designed to meet current transportation design and safety standards for a main traffic arterial as defined by the City of Folsom and California Department of Transportation (Caltrans). Features would include a four-lane thoroughfare with approach roads, bridge structure, terminus and feeder intersections, turn lanes, associated facilities, and bicycle and pedestrian access. The main features of each alternative are described below. A more complete description can be found in the Corps' environmental documentation.



US Army Corps of Engineers
Sacramento District

American River Watershed Project

Folsom Dam Raise and Folsom Bridge SEIS/EIR

Figure 1. - Project Location Map

May 20, 2005

No Scale

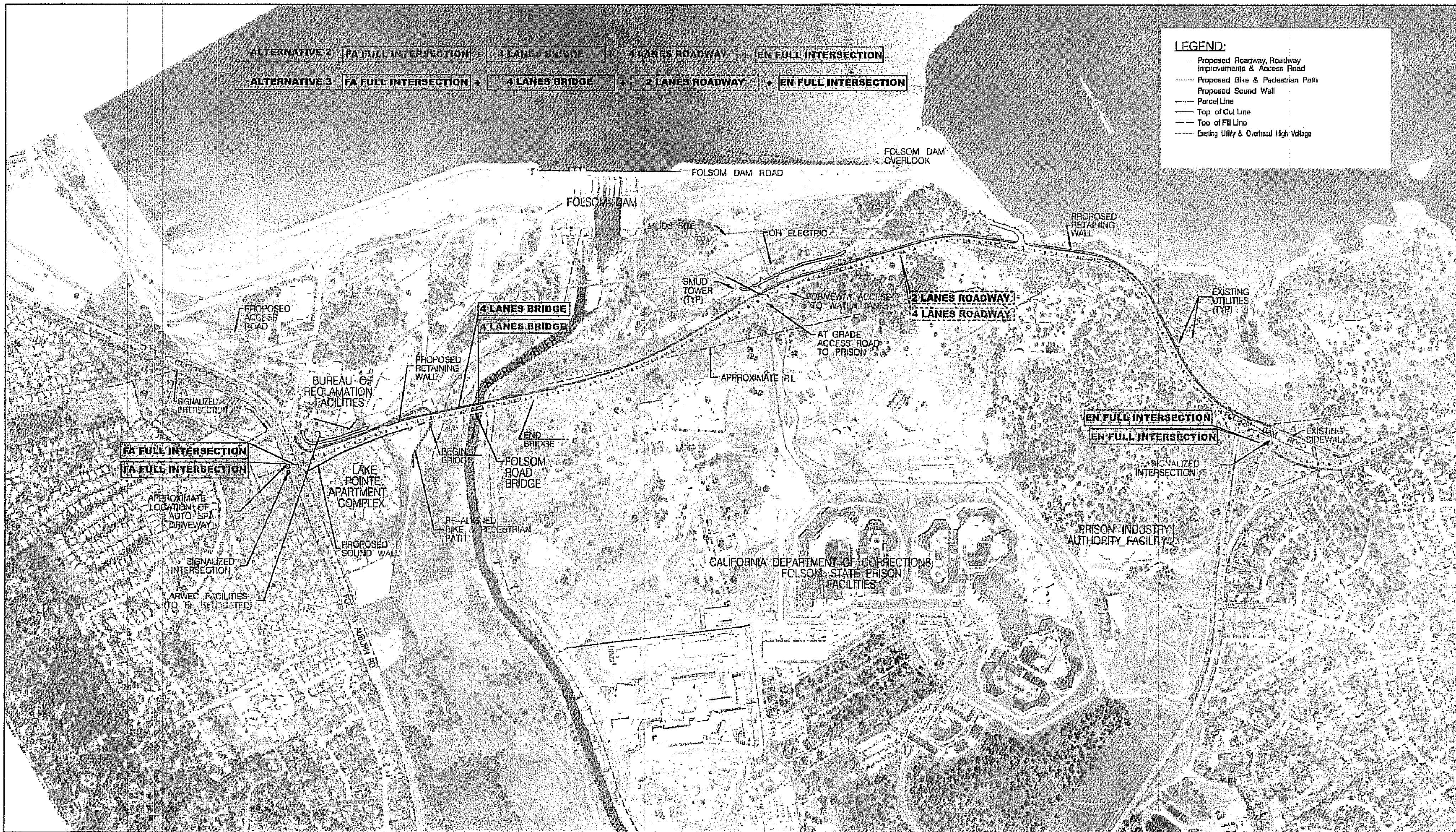
US Army Corps of Engineers
Sacramento District

American River Watershed Project

Folsom Bridge SEIS/SEIR

Figure 2. - Project Study Area

February 10, 2006	Scale 1" = 800'



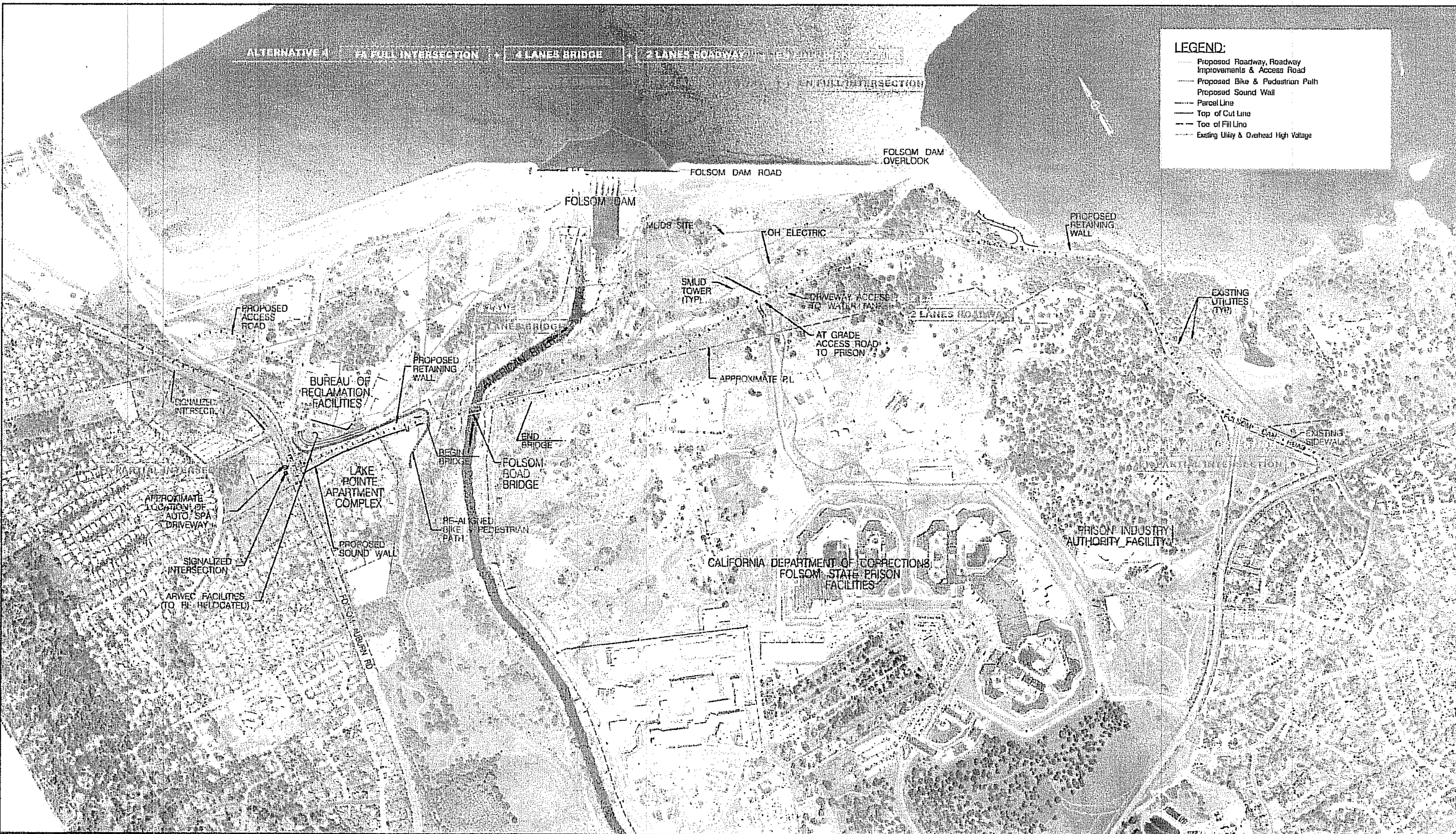
US Army Corps of Engineers
Sacramento District

American River Watershed Project

Folsom Bridge SEIS/SEIR

Figure 3. - Alternative 2 and Alternative 3

February 10, 2006	Scale 1" = 800'



US Army Corps of Engineers
Sacramento District

American River Watershed Project

Folsom Bridge SEIS/SEIR

Figure 4. - Alternative 4 and Alternative 5

February 10, 2006	Scale 1" = 800'

Alternative 2 – Four-Lane Bridge, Four-Lane Road, Full Intersections

Folsom Dam Road and Bridge

Intersection of Folsom Dam Road and East Natoma Street. The existing intersection at Folsom Dam Road and East Natoma Street would be reconfigured to accommodate four lanes of traffic flow and improve traffic circulation. A new signaled T-intersection would be constructed to the northwest, replacing the existing four-way intersection. At the T-intersection, two left turn lanes and one right turn lane northbound, and two left turn lanes and one right turn land eastbound would be provided to accommodate traffic flow. New four-lane segments of roadway would be constructed east and southwest from the new intersection, eventually transitioning into the existing two lanes of East Natoma Street.

The existing intersection with Briggs Ranch Drive would be eliminated and a new segment of Briggs Ranch Drive would be constructed southwest of the new Folsom Dam Road/East Natoma Street. Portions of the old intersection of Folsom Dam Road and East Natoma Street would be removed. The exisintg segment of East Natoma Street south of the old intersection would likely be abandoned

Roadway from Intersection to Bridge. The new roadway segment from the intersection at East Natoma Street would generally follow the existing Folsom Dam Road alignment to a veer-off about 1,000 feet south of the Folsom Dam overlook driveway. Construction of this portion of the roadway would include some cut into the existing hillside to provide clearance for the new four-lane roadway. Additionally, there would be a 300-foot-long retaining wall along the east side of the road to support the fill material for the roadway. At the veer-off point, the road would rotate to the southwest Folsom Modifications Project area (proposed gated spillway structure) and then continue through California Department of Corrections (CDC) facilities to the river. This alignment would cross about 4 acres of CDC property.

Construction of each new roadway segment would include site preparation (cut, fill, and grading), laying a base of gravel, laying the riding surface of asphalt, and finishing the road with striping. The excess cut or ripped material would be removed, temporarily stockpiled, and reused for future work by Reclamation or the City of Folsom. Construction right-of-way on the roadway would be 10 to 15 feet beyond the cut and fill line. The new four-lane roadway would have 12-foot-wide lanes and 8-foot-wide shoulders.

Work along the existing Folsom Dam Road alignment would be done in stages (half the roadway at one time) to accommodate movement of traffic during construction. The old roadway surface (asphalt) would be removed, incorporated into roadway fill, or recycled.

Reclamation and Prison Access Roads.
Construction of the gated auxiliary spillway would convert the part of the staging area for the Folsom Dam Modification Project to a concrete structure for outflow management and/or dam safety. The remaining portion of this area would likely be used as a staging area for this project and an access road would be constructed to the staging area and spillway for maintenance.

A new intersection and short roadway would be constructed to connect the new Folsom Dam Road to the existing dam road for Reclamation's operations and maintenance activities. Farther west, an access driveway from the new Folsom Dam Road would be provided to Reclamation and the City of Folsom's water control structure. In addition, access would be provided via a left turn lane to allow for continued access CDC's Sacramento-Folsom firing range.

Bridge Across American River. The new Folsom Dam Road would continue west and connect to the east bridge abutment, which would be located 500 feet east of the river. The bridge's orientation would align slightly north to allow the road to connect to the existing Folsom Dam Road intersection at Folsom-Auburn Road just south of most of Reclamation's facilities.

Two roads would provide access for workers, vehicles, and equipment to the bridge construction area. Access from the east would be provided via an existing dirt road that would connect with a new section of Folsom Dam Road, access from the west would be provided via Reclamation's existing road to the powerhouse.

The area just west of the proposed bridge is covered with about 80 feet of fill material previously excavated during construction of Folsom Dam. This material is not suitable for construction and would need to be excavated and removed prior to construction of the new bridge

The new bridge would be a pre-stressed concrete, cast-in-place, segmental box girder structure. The bridge span and concrete abutments would be about 915 feet long. The span would be supported by two piers placed above the mean river water level in the river bank areas below. The bridge span would have an estimated clearance of 180 feet above the river (top of deck to mean river surface).

The bridge would be designed to allow stormwater to drain by gravity off the roadway surface to the edge of the bridge. The stormwater would also contain oils, fuels, and other potentially hazardous materials from the vehicle traffic crossing the bridge. To avoid contamination of the land or river below, the bridge would have a water collection system. The stormwater would flow into drains at the end of the bridge, collect in pipelines, if needed, gravity flow off the bridge, and discharge into a siltation basin containing riparian or similar vegetation to bio-remediate the runoff.

Roadway from Bridge to Intersection. The west bridge abutment would be located 400 feet west of the river. From the abutment, the alignment of the new roadway segment would cross the north side of existing the Reclamation storage yard; a dam service road, the northeast edge of the Lake Point Apartment complex, and south side of the American River Water Education Center (ARWEC) facilities, and connect to the existing Folsom-Auburn Road across from the existing driveway to the Auto Spa. This alignment would affect the ARWEC, some existing Reclamation storage and parking, and Lake Point Apartment complex facilities. Sound walls and landscaping would be incorporated into the roadway design

Intersection of Folsom Dam Road and Folsom-Auburn Road. A new intersection would be constructed at the terminus of the new roadway at Folsom-Auburn Road. The new intersection would include signals and medians, incorporate access to the Auto Spa, and accommodate four lanes of traffic flow. Folsom-Auburn Road would need to be widened to provide right turn/acceleration lanes.

Traffic flow at the reconfigured intersection would be diverted to the new Folsom Dam Road, and the existing roadway to Folsom Dam would be closed permanently or be a restricted non-signaled driveway access for emergency and maintenance vehicles.

A new signaled T-intersection and two-lane access road about 1,200 feet northwest of the existing Folsom Dam Road intersection would be constructed for Reclamation to provide secured access to their facilities, and possible access to new ARWEC facilities.

Relocations. Several existing facilities would need to be relocated prior to construction of the Folsom Dam Road segment west of the new bridge. These include Reclamation's storage yard, the ARWEC, and California State Park's Folsom Lake SRA offices, and possibly some Lake Point Apartment complex features.

Materials and parking at the Reclamation storage yard would be relocated to an area east of the Reclamation shop buildings near the existing HTRW storage area. The Federal Government would continue to own the existing storage yard property and likely leave it as open space.

The existing ARWEC and State Parks offices would be to new buildings on about 5 acres near the new intersection. Relocation of ARWEC and State Parks personnel and functions would be coordinated to minimize disruption as much as possible. Some of the existing buildings would be demolished and some would be retained for other purposes.

Utilities. The types of utilities in the project area include electricity, gas, telephone, cable, waste water and sewer, and water supply. Any utilities affected by relocation of facilities or construction of the intersections, roadway, and bridge would be relocated or replaced. These include wooden poles carrying telephone and cable utilities; utilities associated with the nine Reclamation buildings, ARWEC, State Parks offices, and Reclamation's storage yard; and one high-powered electric utility tower owned by SMUD. The wooden poles would be relocated, and the tower would be relocated to a nearby location approved by SMUD and replaced with a steel pole structure.

Bicycle/Pedestrian Trails. Two types of bicycle trails would be constructed to provide continuous access between East Natoma Street and Folsom-Auburn Road, as well as additional recreational opportunities for biking and walking. A new Class 1 bike trail would extend along the north side of the new Folsom Dam Road. This 10-foot-wide trail would be surfaced with asphalt and be physically separate from the roadway. Both bicyclists and pedestrians could use this bike trail.

Two new Class 2 bike trails would extend along the north and south shoulders of the new roadway. These 8-foot-wide trails would be surfaced in asphalt and physically part of the new roadway surface. While bicyclists could use these trails, pedestrian use would be restricted to the Class 1 bicycle/ pedestrian trail due to safety issues.

Currently, there are several segments of existing bike trail in the project area. These include: (1) Class 1 bike trails on each side of the roadway at the intersection of Briggs Ranch Drive and East Natoma Street and (2) Jedediah Smith bike trail on the west side of the river. These trails were constructed, and are currently maintained by the City of Folsom and State Parks, respectively. The new Class 1 bike trail would connect to these existing bike trails, as well as incorporate the section of trail along the alignment of Folsom Dam Road north of East Natoma Street into the design.

In addition, a new bike trail underpass would be designed and constructed about 800 feet east of the existing Folsom Dam Road intersection with Folsom-Auburn Road.

Security Measures. Security measures would be implemented to prohibit public access to secured CDC, Reclamation, and State Parks facilities both during and after construction of the project. These would include setbacks, fencing walls, locked gates, lights and signs.

Staging Areas. Although the contractor would be responsible for identifying the final staging areas, the most likely locations would be the Reclamation storage yard and the triangle intersection area near the intersection of Folsom Dam Road and East Natoma Street. Other possible areas include the overlook area and the storage area near the CDC firing range intersection.

Excavation, Temporary Stockpile, and Disposal Area. Some of the excavated soil material would be used as fill elsewhere on the Folsom Bridge Project. Since the quantity of this excavated material would be sufficient to meet the fill needs of the project, no soil would need to be obtained and imported for the project. Material such as gravel, concrete, and asphalt to construct the roadway, bridge, and bike trails would be obtained and transported by truck from local commercial sources.

Excess excavated material would be temporarily stockpiled near the excavated area for future use in other proposed Folsom Dam work. Specific sites have not yet been coordinated with Reclamation.

Disposal of excavated material not suitable for fill, such as vegetation and debris, would be disposed of at a local landfill. Asphalt, concrete, and other material from the old roadway segments would be removed, incorporated into roadway fill, or recycled. Materials from the SMUD tower structure would remain the property of SMUD, who would recycle or dispose of the materials. Building debris from relocation of ARWEC, State Parks offices, and apartment complex facilities would be recycled or disposed of at a local landfill.

Operation and Maintenance. The City of Folsom would be responsible for the operation and maintenance of the new intersections, Folsom Dam Road, and the bridge over the American River following transfer of ownership from the Federal Government. The intersections, roadway, and bridge would be included in the City's plan and schedule for regular street operation and maintenance.

Construction Details and Schedule. All intersections and roadway sections would be constructed in accordance with applicable Corps, Caltrans, Sacramento County, and City of Folsom standards. Prior to initiation of construction, the contractor would prepare a traffic management plan identifying measures to minimize traffic congestion and delays and ensure public safety. These measures could include scheduling construction activities to avoid commute hours, posting warning signs and speed limits, and using flaggers.

Roadway segments and the new bridge would be constructed at the same time. The work would require between 80 and 100 workers per day. Parking for the worker vehicles would be provided near East Natoma Street and Folsom-Auburn Road, and the workers would be transported to the work areas.

Construction of the new roadway and bridge could begin in the summer/fall of 2007 and be completed in 1.5 to 2 years. Work would be normally limited to daylight hours, with possible suspensions of work during local commute hours when traffic is allowed on the Folsom Dam Road segment. If necessary, work could be conducted during evening or night hours in areas away from residential neighborhood or commercial areas.

Alternative 3 – Four-Lane Bridge, Two-Lane Road, Full Intersections

The features of Alternative 3 are very similar to Alternative 2 except: (1) a portion of the new road where it veers to the southwest and extends below the proposed spillway structure would be a two lane roadway (rather than four lanes) to the river, and (2) the bike trails would be Class 2 (refer to Figure 3).

Alternative 4 – Four-Lane Bridge, Two-Lane Road, Partial Intersection

The features of Alternative 4 are very similar to Alternative 3, except the intersection of the new roadway with East Natoma Street. This intersection would be reconfigured and signaled across from Briggs Ranch Drive (refer to Figure 4)

Alternative 5 – Four-Lane Bridge, Two-Lane Road, Partial Intersections

The features of Alternative 5 are very similar to Alternative 4, except the intersections at each end of the new road would be reconfigured for less traffic lanes and the new roadway would be two lanes. The retaining wall where the road veers toward the river would not be needed for this alternative.

More specific information on the various alternatives being considered as well as those not studied in greater detail can be found in the Corps' environmental documents.

Prior to working on assessing impacts of the project, a multi-agency team working toward a comprehensive plan for mitigation for the entire American River Watershed Investigation was formed. Agencies represented on this team include the Corps, Service, Sacramento County Parks and Recreation, Sacramento Area Flood Control Association, and the California Department of Water Resources. In order to complete an evaluation of adverse project impacts on fish and wildlife species and their habitat and determine any compensation measures, a typical site suitable for compensation needed to be identified. The multi-agency team selected a site located at Rossmoor Bar within the American River Parkway as a typical candidate site for a mitigation area. This site exhibited the characteristics, mainly annual grassland with some scatted areas of oak woodland, which the team considered essential for a mitigation site. Selection of this site was also coordinated with the State Reclamation Board. It is one of several sites which are being considered for use as a mitigation site for the bridge project within the American River Parkway. Selection of an actual site will be coordinated with the agencies above and other local governments.

FISH AND WILDLIFE RESOURCES

A detailed discussion of the existing fish and wildlife resources in the project area is included in the Service's earlier FWCA reports for this project (USFWS 2001, 2005a), and other associated Corps projects in this area (USFWS 1994, 2001). These reports should be consulted for more specific information on these resources.

The proposed construction site is best described as a complex of oak woodland, riparian areas associated with seasonal drainages and swales, seasonal wetlands, and annual grassland. The oak woodland generally consists of an overstory dominated by oak and California buckeye trees, a midstory of younger oaks, buckeyes, and elderberry shrubs, and an understory comprised of poison oak, herbaceous plants, and non-native grass species. The riparian areas are dominated by cottonwood trees and some willows with an understory of poison oak, buckeye, and elderberry shrubs, and annual grasses. The seasonal wetland areas contain species such as cattail, sedges, and brome. A list of the plant species identified in the seasonal wetland areas of the project is included in a wetland delineation report completed for this project by the Service (2005b).

The area supports typical mammal species including small mammals and deer. Bird species in the area include typical passerine species, turkeys and California quail, and raptors such as red-tailed hawk. A bald eagle was observed soaring in the area in February 2005. Waterfowl (mallards and Canada geese) and other waterbirds, such as killdeer, egrets, and herons utilize the seasonal wetland areas in the project area and the American River.

The American River, downstream of Folsom Dam to Nimbus Dam, supports several species of fish including bass, rainbow trout, channel catfish, sculpin, wakasagi, mosquitofish, and other species. Downstream of Nimbus Dam the river supports anadromous species including Chinook salmon, steelhead, striped bass and American shad.

SERVICE MITIGATION POLICY

The recommendations provided herein for the protection of fish and wildlife resources are in accordance with the Service's Mitigation Policy as published in the Federal Register (46:15; January 23, 1981).

The Mitigation Policy provides Service personnel with guidance in making recommendations to protect or conserve fish and wildlife resources. The policy helps ensure consistent and effective Service recommendations, while allowing agencies and developers to anticipate Service recommendations and plan early for mitigation needs. The intent of the policy is to ensure protection and conservation of the most important and valuable fish and wildlife resources, while allowing reasonable and balanced use of the Nation's natural resources.

Under the Mitigation Policy, resources are assigned to one of four distinct Resource Categories, each having a mitigation planning goal which is consistent with the fish and wildlife values involved. The Resource Categories cover a range of habitat values from those considered to be unique and irreplaceable to those believed to be much more common and of relatively lesser value to fish and wildlife. However, the Mitigation Policy does not apply to threatened and endangered species, Service recommendations for completed Federal projects or projects permitted or licensed prior to enactment of Service authorities, or Service recommendations related to the enhancement of fish and wildlife resources.

In applying the Mitigation Policy during an impact assessment, the Service first identifies each specific habitat or cover-type that may be impacted by the project. Evaluation species which utilize each habitat or cover-type are then selected for Resource Category analysis. Selection of evaluation species can be based on several rationale, as follows: (1) species known to be sensitive to specific land- and water-use actions; (2) species that play a key role in nutrient cycling or energy flow; (3) species that utilize a common environmental resource; or (4) species that are associated with Important Resource Problems, such as anadromous fish and migratory birds, as designated by the Director or Regional Directors of the Fish and Wildlife Service. (Note: Evaluation species used for Resource Category determinations may or may not be the same evaluation species used in a HEP application, if one is conducted). Based on the relative importance of each specific habitat to its selected evaluation species, and the habitat's relative abundance, the appropriate Resource Category and associated mitigation planning goal are determined.

Mitigation planning goals range from "no loss of existing habitat value" (i.e., Resource Category 1) to "minimize loss of habitat value" (i.e., Resource Category 4). The planning goal of Resource Category 2 is "no net loss of in-kind habitat value"; to achieve this goal, any unavoidable losses would need to be replaced in-kind. "In-kind replacement" means providing or managing substitute resources to replace the habitat value of the resources lost, where such substitute resources are physically and biologically the same or closely approximate those lost.

In addition to mitigation planning goals based on habitat values, Region 1 of the Service, which includes California, has a mitigation planning goal of no net loss of acreage and value for wetland habitat. This goal is applied in all impact analyses.

In recommending mitigation for adverse impacts to fish and wildlife habitat, the Service uses the same sequential mitigation steps recommended in the Council on Environmental Quality's regulations. These mitigation steps (in order of preference) are: avoidance, minimization, rectification of measures, measures to reduce or eliminate impacts over time, and compensation.

Five fish and/or wildlife habitats were identified in the Folsom Bridge Project area which had potential for impacts from the project. These are oak woodland, riparian woodland, seasonal wetland, annual grassland, and other. The resource categories, evaluation species, and mitigation planning goal for the habitats impacted by the project are summarized in Table 1.

Table 1. Resource categories, evaluation species, and mitigation planning goal for the habitats possibly impacted by the Folsom Bridge Project, California.

COVER-TYPE	EVALUATION SPECIES	RESOURCE CATEGORY	MITIGATION GOAL
Oak woodland	Acorn woodpecker Turkey Mule deer	2	No net loss of in-kind habitat value.
Riparian woodland	Swainson's hawk Wood duck Northern oriole	2	No net loss of in-kind habitat value or acreage.
Seasonal wetland	Mallard Egret	2	No net loss of in-kind habitat value or acreage.
Annual grassland	Red-tailed hawk	3	No net loss of habitat value while minimizing loss of in-kind habitat value.
Other	None	4	Minimize loss of habitat value

The evaluation species selected for the oak woodland that would be impacted are acorn woodpecker, turkey, and mule deer. Acorn woodpeckers utilize oak woodlands for nearly all their life requisites; 50-60 percent of the acorn woodpecker's annual diet consists of acorns. Acorn woodpeckers can also represent impacts to other canopy-dwelling species. Turkeys forage and breed in oak woodlands and are abundant in the project area. Mule deer also heavily depend on acorns as a dietary item in the fall and spring; the abundance of acorns and other browse influence the seasonal pattern of habitat use by deer. These latter species represent species which utilize the ground component of the habitat and both have important consumptive and non-consumptive human uses (i.e., hunting and bird watching). Based on the high value of oak woodlands to the evaluation species, and their declining abundance, the Service has determined oak woodlands which would be affected by the project should be placed in Resource Category 2, with an associated mitigation planning goal of "no net loss of in-kind habitat value."

The evaluation species selected for the riparian woodland that would be impacted are Swainson's hawks, wood ducks, and northern orioles. Woody riparian vegetation provides important cover, and roosting, foraging, and nesting habitat for these species. Large diameter trees also provide nesting sites for species such as wood ducks and Swainson's hawks. Riparian woodland cover-types are of generally high value to the evaluation species, and are overall, extremely scarce (less than 2 percent remaining from pre-development conditions). Therefore, the Service finds that any riparian woodland cover-type that would be impacted by the project should be placed in Resource Category 2, with an associated mitigation planning goal of "no net loss of in-kind habitat value." In addition, the Service's regional goal of no net loss of wetland acreage or habitat values, whichever is greater, would apply to these habitat types.

The mallard duck and egrets were selected as the evaluation species for the seasonal wetland cover-type. These species were selected because of: (a) their dependence on wetlands for feeding and nesting, (b) their ability to represent other waterfowl and water-related birds using these habitats, (c) their importance for consumptive and non-consumptive human uses (i.e., hunting and bird watching), and (d) the Service's responsibility for their management, under the Migratory Bird Treaty Act. These wetland habitats occur in the project area typically occur in association with water ponding or in the swales and drainages occurring during the rainy season in the project area. These wetlands provide valuable habitat for many water-birds including waterfowl, shorebirds, and wading birds. These habitats are severely reduced in the project area and ecoregion. Therefore, the Service designates these habitats in the project area potentially impacted by the project as Resource Category 2. Our associated mitigation planning goal is for "no net loss of in-kind habitat value or acreage."

The evaluation species selected for the annual grassland cover-type is the red-tailed hawk, which utilizes these areas for foraging. This species was selected because of the Service's responsibility for their protection and management under the Migratory Bird Treaty Act, and their overall high non-consumptive values to humans. Annual grassland areas potentially impacted by the project vary in their relative values to the evaluation species, depending on the degree of human disturbance, plant species composition, and juxtaposition to other foraging and nesting areas. Therefore the Service designates the annual grassland cover-type in the project area as Resource Category 3. Our associated mitigation planning goal for these areas is "no net loss of habitat value while minimizing loss of in-kind habitat value."

No evaluation species were identified for the "Other" cover-type. This cover-type encompasses those areas which do not fall within the other cover-types such as gravel and paved roads, parking areas, buildings, bare ground, riprap, etc. Generally this cover-type would not provide any significant habitat value for wildlife species. Therefore the Service designates the "Other" cover-type in the project area as Resource Category 4. Our associated mitigation planning goal for these areas is "minimize loss of in-kind habitat value."

CONCLUSIONS

All four construction alternatives have similar impacts and compensation needs based on the Habitat Evaluation Procedures conducted for this project (Appendix A). The difference in compensation need between the least impact alternative (Alternative 5) to the most impacting alternative (Alternative 2) is 5.96 acres. In all alternatives, annual grasslands would be replanted when disturbance ends to minimize the effect of work, so no additional compensation measures were identified. No mitigation measures are recommended for the "other" cover-type. Table 3 summarizes the acres impacted and compensation need by cover-type for all alternatives. The impacts of the alternatives may change as the design is further refined, however the impacts of each alternative relative to each other should not change.

As part of alternative selection and bridge design, the Corps needed to conduct an initial phase of the project which included material borings to determine material conditions and engineering properties for use in construction of the bridge. There were 16 core borings and 20 auger borings. These borings were conducted on both sides of the river. The core borings were about 75 feet deep and the auger borings were about 20 feet deep. All equipment was truck or track mounted and accessed the core/auger sites via existing dirt or paved roads, new dirt roads, or brought in by helicopter. The impact of constructing any new roads was included in the HEP

Fifteen elderberry shrubs have been located within 100 feet of proposed boring for the Folsom Dam Bridge Project. The Corps consulted with the Service on the effects of the project to these shrubs, which is the host plant for the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), a federally listed threatened species under the Endangered Species Act (ESA), as amended (Service files 1-1-05-F-0108; 1-1-05-F-0222; 1-1-06-I-0335) (Appendix B). The Corps developed conservation measures to avoid and minimize effects on the beetle based on the Service's July 9, 1999, *Conservation Guidelines for the Valley Elderberry Longhorn Beetle*. The Corps' proposed conservation measures include transplanting directly impacted shrubs to the American River Parkway and planting elderberry seedlings and associated native plants at the proposed compensation site for this project once the site is selected. See Appendix B for more complete information on the consultation and its history.

Once the preferred alternative is selected, the Corps will reinitiate consultation with the Service for project effects on the valley elderberry longhorn beetle and any other listed species affected by the proposed project.

Table 3. Summary of Cover-Types, Acres Impacted, Net Change in Average Annual Habitat Units with- and Without-Project and Compensation Need for the direct impacts of construction of the Folsom Bridge Project, California

Alternative 2—Four Lane Bridge, Four Lane Road, Full Intersections.

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	33.87	37.31	2.39	-35.24	51.67
Riparian woodland	5.46	8.37	0.05	-8.32	5.80
Seasonal wetland	2.51	2.99	0.63	-1.20	2.51
Annual grassland	N/A	N/A	N/A	N/A	N/A
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**41.84**				**59.98**

Alternative 3 – Four-Lane Bridge, Two-Lane Road, Full Intersections.

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	32.87	36.18	2.31	-33.87	50.10
Riparian woodland	5.46	8.37	0.05	-8.32	5.80
Seasonal wetland	2.51	2.99	0.63	-1.20	2.51
Annual grassland	N/A	N/A	N/A	N/A	N/A
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**40.84**				**58.41**

Alternative 4. –Four-Lane Bridge, Two-Lane Road, Partial Intersection (East)

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	31.19	34.31	2.19	-32.12	47.51
Riparian woodland	5.46	8.37	0.05	-8.32	5.80
Seasonal wetland	2.28	2.72	0.27	-2.45	2.28
Annual grassland	N/A	N/A	N/A	N/A	N/A
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**38.93**				**55.59**

Alternative 5. –Four Lane Bridge, Two-Lane Road, Two Partial Intersections

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	30.19	33.18	2.13	-31.05	45.94
Riparian woodland	5.46	8.37	0.05	-8.32	5.80
Seasonal wetland	2.28	2.72	0.27	-2.45	2.28
Annual grassland	N/A	N/A	N/A	N/A	N/A
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**37.93**				**54.02**

Note: The compensation need for the riparian woodland and seasonal wetland cover-types was slightly less the figure shown in Table 3. The figure was adjusted up to the acreage impacted to conform with the Service's Mitigation Policy of no net loss of in-kind habitat value or acreage for Resource Category 2 designations

RECOMMENDATIONS

The Service recommends the Corps:

GENERAL

1. Avoid impacts to oak woodlands and riparian areas outside construction easements by fencing their boundaries with orange construction fencing or cyclone fencing just outside the dripline of associated woody vegetation near these areas. All woody vegetation adjacent to staging areas and access and haul routes should be similarly fenced.

2. Avoid impacts to nesting migratory birds by only clearing riparian or seasonal wetland vegetation as necessary during the summer months after young-of-the year birds have fledged the nest.

3. Minimize impacts to fish and wildlife resources and their habitat by restricting off-road vehicle use to established roads in the project area and confining parking to established areas (parking lot and staging area).

4. Minimize impacts in all disturbed portions of construction easements, borrow sites, staging areas, and haul routes by seeding these areas with native annual grasses at the completion of construction, or when these disturbed areas are to be undisturbed for the growing season.

ALTERNATIVE 2

5. Compensate for the loss of 33.87 acres of oak woodland habitat by developing 51.67 acres of oak woodland habitat at a site approved by the Service.

6. Compensate for the loss of 5.46 acres of riparian woodland habitat by developing 5.80 acres of riparian habitat at a site approved by the Service.

7. Compensate for the loss of 2.51 acres of seasonal wetland habitat by developing 2.51 acres of seasonal wetland habitat at a site approved by the Service, or alternatively, purchase credits at a Service-approved mitigation bank which service's the project area.

ALTERNATIVE 3

8. Compensate for the loss of 32.87 acres of oak woodland habitat by developing 50.10 acres of oak woodland habitat at a site approved by the Service.

9. Compensate for the loss of 5.46 acres of riparian woodland habitat by developing 5.80 acres of riparian habitat at a site approved by the Service.

10. Compensate for the loss of 2.51 acres of seasonal wetland habitat by developing 2.51 acres of seasonal wetland habitat at a site approved by the Service, or alternatively, purchase credits at a Service-approved mitigation bank which service's the project area.

ALTERNATIVE 4

11. Compensate for the loss of 31.19 acres of oak woodland habitat by developing 47.51 acres of oak woodland habitat at a site approved by the Service.

12. Compensate for the loss of 5.46 acres of riparian woodland habitat by developing 5.80 acres of riparian habitat at a site approved by the Service.

13. Compensate for the loss of 2.28 acres of seasonal wetland habitat by developing 2.28 acres of seasonal wetland habitat at a site approved by the Service, or alternatively, purchase credits at a Service-approved mitigation bank which service's the project area.

ALTERNATIVE 5

14. Compensate for the loss of 30.19 acres of oak woodland habitat by developing 45.94 acres of oak woodland habitat at a site approved by the Service.

15. Compensate for the loss of 5.46 acres of riparian woodland habitat by developing 5.80 acres of riparian habitat at a site approved by the Service.

16. Compensate for the loss of 2.28 acres of seasonal wetland habitat by developing 2.28 acres of seasonal wetland habitat at a site approved by the Service, or alternatively, purchase credits at a Service-approved mitigation bank which service's the project area.

ENDANGERED SPECIES

17. Re-survey the construction and staging areas, borrow sites, access routes and haul roads for the presence of elderberry shrubs prior to construction activity. The presence of any new shrubs with stems measuring 1-inch or greater at ground level should be reported to the Service and consultation under section 7 of the ESA should be reinitiated.

18. Implement the conservation measures outlined in the Service's May 4, 2005, biological opinion (Service file 1-1-05-F-0108; 1-1-05-F-0222; 1-1-06-I-0335) for the boring work and reinitiate consultation if there are any changes in the proposed work.

19. Provide worker awareness training to all construction personnel alerting them to the purpose of the fencing provided to protect the habitat adjacent to the construction zones. This can be combined with the worker awareness training to be conducted for listed species such as the valley elderberry longhorn beetle.

20. Complete consultation with the California Department of Fish and Game for species protected under the California Endangered Species Act.

REFERENCES

USFWS (U.S. Fish and Wildlife Service). 1994. Planning Aid Report for the American River Watershed Investigation, Raising Folsom Dam Alternative, California. Sacramento Fish and Wildlife Office, Sacramento, California.

_____________. 2001. Fish and Wildlife Coordination Act Report for the American River Watershed Investigation, Folsom Dam Outlet Modification Project, California. Sacramento Fish and Wildlife Office, Sacramento, California. 31 pp. + appendices.

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_____________. 2005a. Supplemental Fish and Wildlife Coordination Act Report for the American River Watershed Investigation, Folsom Dam Modification Project, California. Sacramento Fish and Wildlife Office, Sacramento, California.

_____________. 2005b. Wetland Delineation Report for the U.S. Army of Engineers. American River Watershed Investigation, Folsom Dam Bridge Project and Folsom Dam Outlet Modification Project, California. Sacramento Fish and Wildlife Office, Sacramento, California. 6 pp. + appendices.

APPENDIX A

AMERICAN RIVER WATERSHED INVESTIGATION, CALIFORNIA

FOLSOM BRIDGE PROJECT

REVISED
HABITAT EVALUATION PROCEDURES

MARCH 2006

INTRODUCTION

The Folsom Bridge Project is part of the Folsom Dam Raise Project, which is a component of the Corps of Engineers' (Corps) American River Watershed Long-Term Project. A final Supplemental Plan Formulation Report/Environmental Impact Statement/ Environmental Impact Report (SEIS/EIR) for the Long-Term Project was completed in February 2002. The subsequent Chief of Engineers' Report was forwarded to Congress for possible authorization for construction.

The Folsom Dam Raise Project includes various features to address the Sacramento area's potential flood risk. The main feature of the project is to raise Folsom Dam up to 10 feet to increase the flood storage capacity behind the dam. Construction of the Dam Raise Project (concurrent with construction of the Folsom Dam Modifications Project) is expected to take place over 20 years. Since numerous closures of the existing Folsom Dam Road would be expected during construction, a temporary bridge was initially proposed in the 2002 report to mitigate the effects of these closures.

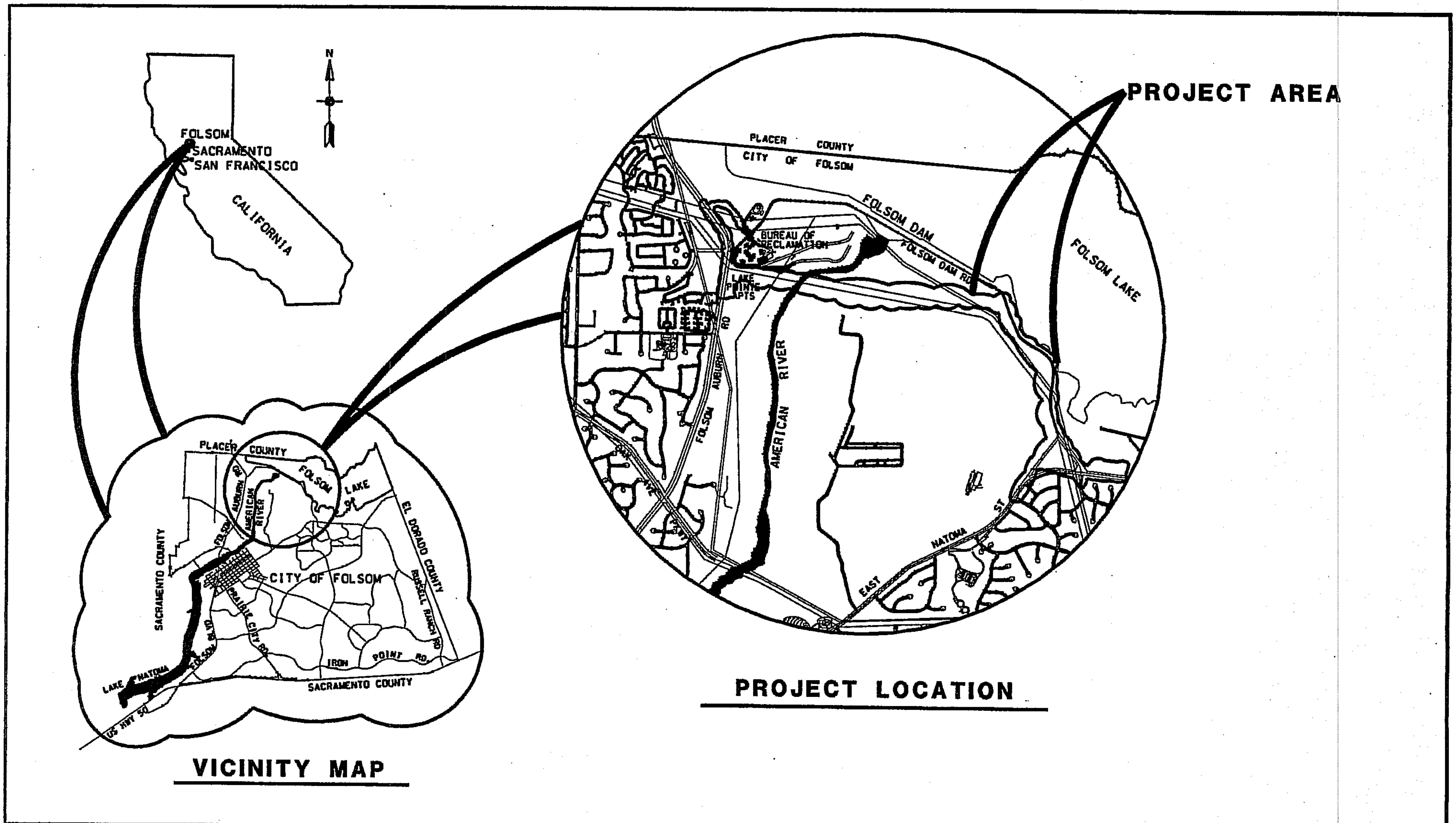
In February 2003, the U.S. Bureau of Reclamation (Reclamation) closed Folsom Dam Road indefinitely for security and public safety reasons. This closure had significant effects on the residents and businesses in the surrounding area. In September 2004, Congress authorized the Folsom Dam Raise Project, including authorization of construction of a permanent bridge just downstream of Folsom Dam.

The Folsom Bridge Project was authorized by Congress in the Energy and Water Development Appropriations Act of 2004 (Public Law 108-137). Since the initial project impact evaluation was conducted by the Service in 2001 (USFWS 2003) for the American River Watershed Long-Term Project, several project refinements have been made. This application of Habitat Evaluation Procedures (HEP) is intended to quantify the impacts on fish and wildlife resources associated with the design for the current bridge proposal

PROJECT DESCRIPTION

The project is located in northeastern Sacramento County, near the City of Folsom, California (Figure 1). Several preliminary road alignment alternatives were evaluated by the Corps for the new Folsom Dam Road connecting East Natoma Street with Folsom-Auburn Road. The alignment that was selected the Folsom Bridge Project begins with a new intersection at East Natoma Street and then generally follows the existing Folsom Dam Road crosses the American River downstream of Folsom Dam and terminates at a new intersection at Folsom-Auburn Road (Figures 2 and 3).

The Corps is evaluating several alternatives for completing this road alignment. Each alternative would provide unrestricted access to both sides of the river near Folsom Reservoir and meet current transportation design and safety standards. A more detailed description of these features is contained in the accompanying Fish and Wildlife Coordination Act report and the Corps'



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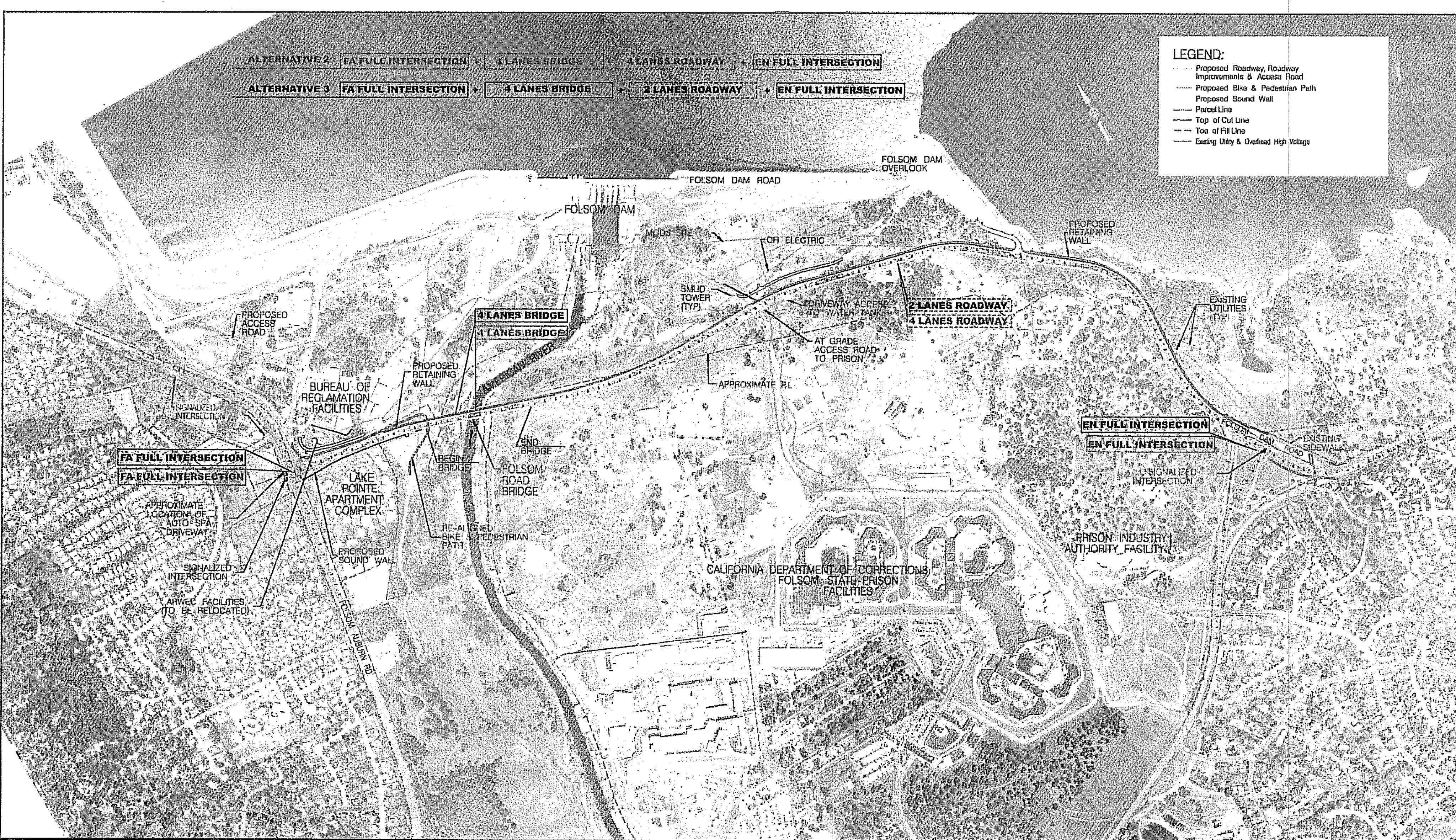
Sacramento District

American River Watershed Project
Folsom Dam Raise and Folsom Bridge SEIS/EIR

Figure 1. - Project Location Map

May 20, 2005	No Scale



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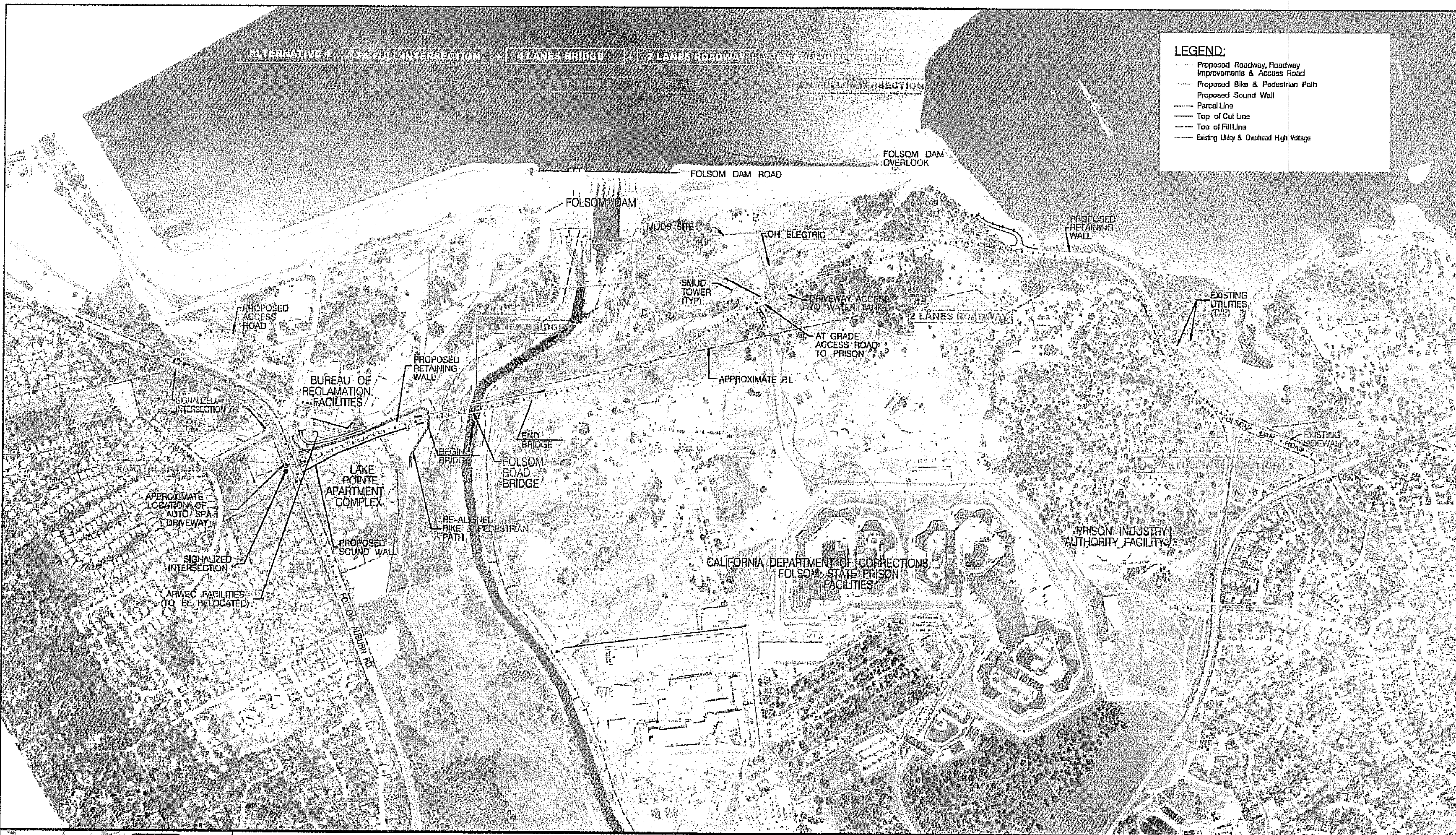
Sacramento District

American River Watershed Project

Folsom Bridge SEIS/SEIR

Figure 2. - Alternative 2 and Alternative 3

February 10, 2006	Scale 1" = 800'



American River Watershed Project

Folsom Bridge SEIS/SEIR

Figure 3. - Alternative 4 and Alternative 5

February 10, 2006	Scale 1" = 800'

environmental documents for this project.

The alternatives are:
Alternative 1 - No Action
Alternative 2 - Four-Lane Bridge, Four-Lane Road, Full Intersections
Alternative 3 - Four-Lane Bridge, Two-Lane Road, Full Intersections
Alternative 4 - Four-Lane Bridge, Two-Lane Road, Partial Intersection (East)
Alternative 5 - Four-Lane Bridge, Two-Lane Road, Two Partial Intersections

METHODOLOGY

HEP is a methodology developed by the Fish and Wildlife Service (Service) and other State and Federal resource and water development agencies which can be used to document the quality and quantity of available habitat for selected fish and wildlife species. HEP provides information for two general types of habitat comparisons: (1) the relative value of different areas at the same point in time; and (2) the relative value of the same areas at future points in time. By combining the two types of comparisons, the impacts of proposed or anticipated land-use and water-use changes on habitat can be quantified. In a similar manner, any compensation needs (in terms of acreage) for the project can also be quantified, provided a mitigation plan has been developed for specific alternative mitigation sites.

A HEP application is based on the assumption that the value of a habitat for selected species or the value of a community can be described in a model which produces a Habitat Suitability Index (HSI). This HSI value (from 0.0 to 1.0) is multiplied by the area of available habitat to obtain Habitat Units (HUs). The HUs and Average Annual Habitat Units (AAHUs) over the life of the project are then used in the comparisons described above.

The reliability of a HEP application and the significance of HUs are directly dependent on the ability of the user to assign a well-defined and accurate HSI to the selected evaluation elements or communities. Also, a user must be able to identify and measure the area of each distinct habitat being utilized by fish and wildlife species within the project area. Both the HSIs and the habitat acreage must also be reasonably estimable at various future points in time. The HEP team, comprised of Corps and Service staff, determined that these HEP criteria could be met, or at least reasonably approximated, for the Folsom Bridge Project, thus HEP was considered an appropriate analytical tool to analyze impacts of the proposed project alternatives[1].

GENERAL HEP ASSUMPTIONS

Some general assumptions are necessary to use HEP and Habitat Suitability Index (HSI) Models in the impact assessment:

[1] For further information on HEP see ESM 100-104 which is available from the Service's Sacramento Fish and Wildlife Office.

Use of HEP:

1. HEP is the preferred method to evaluate the impacts of the proposed project on fish and/or wildlife resources.
2. HEP is a suitable methodology for quantifying project-induced impacts to fish and wildlife habitats.
3. Quality and quantity of fish and wildlife habitat can generally be numerically described using the indices derived from the HSI models and associated habitat units.
4. The HEP assessment is applicable to the habitat types being evaluated.

Use of HSI Models

5. HSI models are hypotheses based on available data.
6. HSI models are conceptual models and may not measure all ecological factors that affect the quality of a given cover-type for the evaluation species (e.g. vulnerability to predation). In some cases, assumptions may need to be made by the HEP Team and incorporated into the analysis to account for loss of those factors not reflected by the model.

The HEP field work for the project was completed by staff from the Service's Sacramento Fish and Wildlife Office and the Corps (Sacramento District) and occurred during March and April 2005. Five cover-types would be permanently impacted by the project including oak woodland, riparian woodland, seasonal wetland, annual grassland and other[2]. These cover-types were mapped by the HEP Team on aerial photographs and the acreage was quantified by a Corps consultant using GIS. The cover-types and acreage affected by the proposed work is summarized in Table 1.

Eight HSI models were used in this HEP application to quantify project impacts. A summary of the models applied for each cover-type is also included in Table 1. The western gray squirrel and plain titmouse models were selected to evaluate the oak woodland cover-type. These species were chosen because they utilize this cover-type for nesting and foraging. The western fence lizard, yellow warbler, and northern oriole models were chosen to evaluate the project impacts to the riparian woodland cover-type. These species were selected because the bird species utilize the riparian tree canopy provided by the cover-type for nesting and foraging. The western fence lizard utilizes the ground component of the cover-type including rocks boulders, and downed wood for shelter and foraging. The red-winged blackbird, great egret (feeding) and California vole models were selected for evaluating impacts to the seasonal wetland cover-type because these species forage, nest, or inhabit this cover-type. The annual grassland and "other" cover-types were not included in the HEP analysis because they do not currently provide significant habitat for wildlife species or the conditions (habitat values) after the completion of work are expected to be similar to pre-project conditions.

2. "Other" encompasses those areas which do not fall within the other cover-types such as gravel and paved roads, parking areas, buildings, bare ground, riprap, etc.

Table 1. Cover-types, acreage, and HSI model used to evaluate impacts of the proposed refinements to the Folsom Bridge Project, California.

COVER-TYPE	ACREAGE (acres)				HSI MODEL
	Alt. 2	Alt. 3	Alt.4	Alt. 5	
Oak Woodland	33.87	32.87	31.19	39.19	Western gray squirrel Plain titmouse
Riparian Woodland	5.46	5.46	5.46	5.46	Northern oriole Yellow warbler Western fence lizard
Seasonal Wetland	2.51	2.51	2.28	2.28	Great egret (feeding) California vole Red-winged blackbird
Annual Grassland	No HEP proposed, disturbed areas will be reseeded after construction.				
Other	No HEP proposed.				
TOTAL	**41.84**	**40.84**	**38.93**	**37.93**	

The cover-type designations and HSI models were also selected in part to be consistent with previous impact analyses completed for the American River Watershed Investigation Long-Term Project (now referred to as Folsom Dam Raise Project) (USFWS 2003) and the American River Watershed Investigation Folsom Dam Modification Project which is occurring concurrently with the Folsom Bridge Project.

FIELD SAMPLING AND DATA COLLECTION

The HEP Team defined direct construction impacts as those that would cause immediate and complete loss of habitat values on the site at the time of project construction. These impacts would occur within the project area along the road alignment between East Natoma Street and Folsom-Auburn Road and where facilities and utilities would be relocated (refer to Figures 2 and 3). All vegetation, rocks, logs, and other debris would be removed from these sites and woody vegetation would not be allowed to re-establish

Data for each cover-type was collected using transects at the sample sites. Generally, transects were laid out perpendicular to the proposed roads or other construction features in the project area. Using line-intercept techniques, the data corresponding to the variables in the HSI models were recorded. Some variables were estimated due to the density of the vegetation (impenetrable) and presence of large stands of poison oak. The number of transects needed to adequately represent the habitat values of each cover-type was determined in the field based on the size of the cover-type and its relative homogeneity as determined by members of the HEP Team. The cover-types, proposed HSI models, and HSI model variables for the Folsom Bridge Project are summarized in Table 2 and the specific data collection methods utilized are summarized below.

Table 2. HEP Cover-types, proposed HSI models, and HSI model variables for the Folsom Bridge Project, California.

COVER-TYPE	PROPOSED HSI MODELS	HSI MODEL VARIABLES
(1) Oak woodland	Western gray squirrel	V1 - Canopy closure of mast-producing species V2 - Density of leaf litter layer V3 - Tree canopy cover V4 - Den site availability per acre
	Plain titmouse	V1 - Tree diameter V2 - Trees per acre V3 - % composition of tree species that are oaks
(2) Riparian woodland	Yellow warbler	V1 - % deciduous shrub crown cover V2 – Average height of deciduous shrub canopy V3 - % deciduous shrub canopy comprised of hydrophytic shrubs
	Northern Oriole	V1 - Average height of deciduous tree shrub V2 – % deciduous tree crown cover V3 – Stand width
	Western fence lizard	V1 - % ground cover V2 – Average size of ground cover objects V3 – Structural diversity/interspersion V4 - % canopy cover
(3) Seasonal wetlands	Great egret (feeding)	V1 - Percentage of area with water 10-23 cm V2 - Percentage of submerged or emergent vegetation cover in zone 10-23 cm deep
	California vole	V1 - Height of herbaceous vegetation V2 - Percent cover of herbaceous vegetation V3 - Soil type V4 - Presence of logs and other types of cover
	Red-winged blackbird	V1 - Predominance of narrow or broadleaf monocots V2 - Water presence throughout the year V3 - Presence or absence of carp V4 - Presence or absence of damselflies or dragonflies V5 - Mix of herbaceous vegetation V6 - Suitability of foraging substrate
(5) Annual grassland	No HEP proposed; disturbed areas will be reseeded after construction is complete.	
(6) Other	No HEP proposed.	

DATA COLLECTION PROCEDURES

Oak Woodland Cover-Type

1. A 50-foot-long transect was laid out at the sample site. Using line-intercept techniques the canopy cover of hard mast producing trees and shrubs, the canopy cover of all trees, and leaf litter were recorded.

2. A 15-foot-wide belt transect was set up along the 50-foot-long transect. Dbh of all trees in the belt transect was measured using a dbh tape. All oak trees were noted on the data sheet.

Riparian Cover-Type

1. A 25-meter-long transect was laid out at the sample site. Using line-intercept techniques the herbaceous canopy cover, herbaceous vegetation height, and shrub crown cover was recorded.

2. A 15-foot-wide belt transect was set up along the 25-meter-long transect. Dbh of all trees in the belt transect was measured using a dbh tape.

Seasonal Wetland Cover-Type

1. A 25-meter-long transect was laid out at the sample site. Using line-intercept techniques the herbaceous vegetation height, water depth and submergent/emergent vegetation cover in water 4-9 inches deep was recorded.

2. A check-list for the remaining variables was constructed and a check mark was placed to indicate the conditions for the particular variable (see data sheet).

The project area was divided into five reaches prior to data collection. Each of the four action alternatives is composed of these reaches to simplify any future project changes and the associated impact which may occur prior to actual construction. Figure 4 depicts the five reaches.

As previously mentioned, when using HEP, it is necessary to determine HSIs for each evaluation species at selected target years, including future years, for both with-project and without-project scenarios, and for proposed mitigation areas. Since it is not possible to empirically determine habitat quality and quantity for future years, future HSI values were projected. This was accomplished by increasing or decreasing the measured baseline SI (Suitability Index) values for each evaluation species, according to probable future conditions; consideration of the HSI model variables; literature review; professional observations; and review of completed restoration and revegetation projects. A summary of these predicted conditions appears in Appendix A-1.
HSI values for all evaluation species were calculated at the completion of field data collection. All SIs and HSIs were calculated by hand, or using a calculator, as appropriate. The equations used to calculate HSIs are contained within each model. The assumptions used in predicting habitat changes in future Target Years and the predicted future scenarios are contained in Appendix A-1.

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American River Watershed Project

Folsom Bridge SEIS/SEIR

Figure 4. - HEP Study Reaches for the Folsom Bridge Project.

February 10, 2006	Scale 1" = 800'

A typical compensation site located in the American River Parkway at Rossmoor Bar on the American River was used in the HEP to quantify the baseline habitat values[3] for what the HEP Team considered a typical candidate mitigation site. The HEP Team developed a compensation scenario based on a suite of assumptions for development of site for each of the cover-types impacted.

The HEP version 2.2 Accounting Software package was used on an IBM-compatible personal computer to calculate HUs, AAHUs, and sizes of the compensation areas needed to offset project impacts to fish and wildlife, for all cover-types evaluated. Copies of the HSI models used for the HEP are attached in Appendix A-2.

RESULTS AND DISCUSSION

This HEP analyzed the impacts of four alternatives for: 1) constructing a new road between the existing Folsom Dam Road intersection at East Natoma Street to Folsom-Auburn Road, with a bridge over the American River (just downstream of Folsom Dam), 2) building new roads and widening existing roads for construction purposes, 3) construction and operation of the staging area, and 4) possible relocation of Reclamation facilities and the American River Water Education Center.

Tables 3-6 summarize the cover-types, acres impacted, net change in AAHUs with- and without the project and compensation need for the four construction alternatives. Based on this analysis, Alternative 5 would have the least impacts in terms of total compensation needs (54.02 acres). Alternative 2 would have the greatest impacts (total compensation need of 59.98 acres). The difference the least and most impact alternatives is 5.46 acres. It should be noted that the impacts of any of the alternatives could significantly change when the details of relocating Reclamation, ARWEC and State Parks facilities are finalized. In all alternatives, annual grasslands would be replanted when disturbance ends to minimize the effects of the project, so no additional compensation measures were identified.

Table 7 summarizes the acres impacted and compensation need by cover-type for all alternatives.

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3 The Rossmoor Bar site was chosen as a typical site to gather baseline habitat values for a compensation site. The actual compensation site could be one of many sites being considered within the Lower American River Parkway

Table 3 Alternative 2. Summary of Cover-Types, Acres Impacted, Net Change in Average Annual Habitat Units With- and Without-Project and Compensation Need for the direct impacts of construction of the Folsom Bridge Project, California

REACH 1

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	8.23	9.14	0.58	-9.08	12.66
Riparian woodland	N/A	N/A	N/A	N/A	N/A
Seasonal wetland	0.31	0.37	0.04	-0.33	0.31
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**8.54**				**12.97**

REACH 2

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	15.95	18.03	1.13	-16.70	25.00
Riparian woodland	N/A	N/A	N/A	N/A	N/A
Seasonal wetland	0.01	0.01	0.00	-0.01	0.01
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**15.96**				**25.01**

REACH 3

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	1.38	1.56	0.10	-1.46	2.16
Riparian woodland	0.60	0.97	0.00	-0.97	0.60
Seasonal wetland	1.39	1.66	0.17	-1.49	1.39
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**3.37**				**4.15**

REACH 4

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	4.65	5.25	0.33	-4.92	7.29
Riparian woodland	1.15	1.86	0.02	-1.84	1.15
Seasonal wetland	N/A	N/A	N/A	N/A	N/A
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**5.80**				**8.44**

REACH 5 (ARWEC AND USBR ACCESS RD)

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	3.66	3.33	0.25	-3.08	4.56
Riparian woodland	3.71	5.54	0.03	-5.51	4.05
Seasonal wetland	0.80	0.95	0.09	-0.86	0.80
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**7.37**				**9.41**

Table 4 Alternative 3. Summary of Cover-Types, Acres Impacted, Net Change in Average Annual Habitat Units with- and Without-Project and Compensation Need for the direct impacts of construction of the Folsom Bridge Project, California

REACH 1

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	8.23	9.14	0.58	-9.08	12.66
Riparian woodland	N/A	N/A	N/A	N/A	N/A
Seasonal wetland	0.31	0.37	0.04	-0.33	0.31
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**8.54**				**12.97**

REACH 2

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	14.95	16.90	1.05	-15.85	23.43
Riparian woodland	N/A	N/A	N/A	N/A	N/A
Seasonal wetland	0.01	0.01	0.00	-0.01	0.01
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**14.96**				**23.44**

REACH 3

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	1.38	1.56	0.10	-1.46	2.16
Riparian woodland	0.60	0.97	0.00	-0.97	0.60
Seasonal wetland	1.39	1.66	0.17	-1.49	1.39
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**3.37**				**4.15**

REACH 4

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	4.65	5.25	0.33	-4.92	7.29
Riparian woodland	1.15	1.86	0.02	-1.84	1.15
Seasonal wetland	N/A	N/A	N/A	N/A	N/A
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**5.80**				**8.44**

REACH 5 (ARWEC AND USBR ACCESS RD)

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	3.66	3.33	0.25	-3.08	4.56
Riparian woodland	3.71	5.54	0.03	-5.51	4.05
Seasonal wetland	0.80	0.95	0.09	-0.86	0.80
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**7.37**				**9.41**

Table 5 Alternative 4. Summary of Cover-Types, Acres Impacted, Net Change in Average Annual Habitat Units with- and Without-Project and Compensation Need for the direct impacts of construction of the Folsom Dam Bridge Project, California

REACH 1

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	6.55	7.27	0.46	-6.81	10.07
Riparian woodland	N/A	N/A	N/A	N/A	N/A
Seasonal wetland	0.08	0.10	0.01	-0.09	0.08
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**6.63**				**10.15**

REACH 2

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	14.95	16.90	1.05	-15.85	23.43
Riparian woodland	N/A	N/A	N/A	N/A	N/A
Seasonal wetland	0.01	0.01	0.00	-0.01	0.01
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**14.96**				**23.44**

REACH 3

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	1.38	1.56	0.10	-1.46	2.16
Riparian woodland	0.60	0.97	0.00	-0.97	0.60
Seasonal wetland	1.39	1.66	0.17	-1.49	1.39
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**3.37**				**4.15**

REACH 4

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	4.65	5.25	0.33	-4.92	7.29
Riparian woodland	1.15	1.86	0.02	-1.84	1.15
Seasonal wetland	N/A	N/A	N/A	N/A	N/A
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**5.80**				**8.44**

REACH 5 (ARWEC AND USBR ACCESS RD)

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	3.66	3.33	0.25	-3.08	4.56
Riparian woodland	3.71	5.54	0.03	-5.51	4.05
Seasonal wetland	0.80	0.95	0.09	-0.86	0.80
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**7.37**				**9.41**

Table 6 Alternative 5. Summary of Cover-Types, Acres Impacted, Net Change in Average Annual Habitat Units with- and Without-Project and Compensation Need for the direct impacts of construction of the Folsom Dam Bridge Project, California

REACH 1

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	6.55	7.27	0.46	-6.81	10.07
Riparian woodland	N/A	N/A	N/A	N/A	N/A
Seasonal wetland	0.08	0.10	0.01	-0.09	0.08
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**6.63**				**10.15**

REACH 2

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	13.95	15.77	0.99	-14.78	21.86
Riparian woodland	N/A	N/A	N/A	N/A	N/A
Seasonal wetland	0.01	0.01	0.00	-0.01	0.01
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**13.96**				**21.87**

REACH 3

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	1.38	1.56	0.10	-1.46	2.16
Riparian woodland	0.60	0.97	0.00	-0.97	0.60
Seasonal wetland	1.39	1.66	0.17	-1.49	1.39
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**3.37**				**4.15**

REACH 4

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	4.65	5.25	0.33	-4.92	7.29
Riparian woodland	1.15	1.86	0.02	-1.84	1.15
Seasonal wetland	N/A	N/A	N/A	N/A	N/A
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**5.80**				**8.44**

REACH 5 (ARWEC AND USBR ACCESS RD)

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	3.66	3.33	0.25	-3.08	4.56
Riparian woodland	3.71	5.54	0.03	-5.51	4.05
Seasonal wetland	0.80	0.95	0.09	-0.86	0.80
Annual grassland	N/A	N/A	N/A	N/A	Re-plant
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	**7.37**				**9.41**

Table 7. Alternative 2. Summary of Cover-Types, Acres Impacted, Net Change in Average Annual Habitat Units with- and Without-Project and Compensation Need for the direct impacts of construction of the Folsom Bridge Project, California

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	33.87	37.31	2.39	-35.24	51.67
Riparian woodland	5.46	8.37	0.05	-8.32	5.80
Seasonal wetland	2.51	2.99	0.63	-1.20	2.51
Annual grassland	N/A	N/A	N/A	N/A	N/A
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	41.84				59.98

Alternative 3. Summary of Cover-Types, Acres Impacted, Net Change in Average Annual Habitat Units with- and Without-Project and Compensation Need for the direct impacts of construction of the Folsom Bridge Project, California

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	32.87	36.18	2.31	-33.87	50.10
Riparian woodland	5.46	8.37	0.05	-8.32	5.80
Seasonal wetland	2.51	2.99	0.63	-1.20	2.51
Annual grassland	N/A	N/A	N/A	N/A	N/A
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	40.84				58.41

Alternative 4. Summary of Cover-Types, Acres Impacted, Net Change in Average Annual Habitat Units with- and Without-Project and Compensation Need for the direct impacts of construction of the Folsom Bridge Project, California

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	31.19	34.31	2.19	-32.12	47.51
Riparian woodland	5.46	8.37	0.05	-8.32	5.80
Seasonal wetland	2.28	2.72	0.27	-2.45	2.28
Annual grassland	N/A	N/A	N/A	N/A	N/A
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	38.93				55.59

Alternative 5. Summary of Cover-Types, Acres Impacted, Net Change in Average Annual Habitat Units with- and Without-Project and Compensation Need for the direct impacts of construction of the Folsom Bridge Project, California

Cover-Type	Acres Impacted	AAHUs Without Project	AAHUs With Project	Net Change in AAHUs	Compensation Need (acres)
Oak woodland	30.19	33.18	2.13	-31.05	45.94
Riparian woodland	5.46	8.37	0.05	-8.32	5.80
Seasonal wetland	2.28	2.72	0.27	-2.45	2.28
Annual grassland	N/A	N/A	N/A	N/A	N/A
Other	N/A	N/A	N/A	N/A	N/A
TOTAL	37.93				54.02

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APPENDIX A-1

DATA ANALYSIS ASSUMPTIONS

REACH 1 EAST NATOMA STREET TO PARKING LOT NEAR SOUTH END OF DAM

PA 1 - Future Without Project (Impact Area)

OAK WOODLAND

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured)
V1 - % canopy closure of trees and shrubs that produce hard mast (65%)
V2 - Density of leaf litter layer (M)
V3 - % tree cover (61%)
V4 - Den site availability (53)

HSI Food $= (V1 \times V2)^{1/2}$ HSI Cover/Reproduction $= (V3 \times V4)^{1/2}$

HSI = 0.46 (lowest of values)

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0

HSI = 0.46

TY 51
V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1

HSI = 0.46

PLAIN TITMOUSE

TY 0 - Baseline (measured)
V1 - dbh
V2 - Number trees/acre
V3 - % trees that are oaks

$$HSI = \frac{V1 + V2 + V3}{3}$$

HSI = 0 .65

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = 0.65

TY 51 V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = 0.65

PA 2 - Future With Project (Impact Area)

Assume: 1. All vegetation removed from temporary and permanent impact zones in year 1
2. temporary easement areas will not be replanted with woody vegetation

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured) HSI = 0.46

TY 1 -	V1 - no trees	SI = 0
	V2 - low leaf litter	SI = 0.2
	V3 - no trees	SI = 0
	V4 - no den sites	SI = 0

HSI Food $= (V1 \times V2)^{1/2} = (0 \times 0.2)^{1/2} = 0$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = (0 \times 0)^{1/2} = 0$

HSI = 0

TY 51- V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1

HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (measured) HSI = 0.65

TY 1 -	V1 - no trees	SI = 0.2
	V2 - no trees	SI = 0
	V3 - no trees	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2}{3} = 0.06$$

TY 51 - V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1

HSI = .06

MP 1 - Management Area - Future Without Project (Compensation Site)

Assume: 1. Annual grassland area selected for conversion to oak woodland.

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated)

V1 - % canopy closure of trees and shrubs that produce hard mast (no trees)	SI = 0
V2 - Density of leaf litter (low)	SI = 0.2
V3 - Den site availability (no trees)	SI = 0

HSI Food $= (V1 \times V2)^{1/2} = (0 \times 0.2)^{1/2} = 0$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = (0 \times 0)^{1/2} = 0$

HSI = 0

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0

HSI = 0

TY 15 - no change from TY 1 HSI = 0

TY 51 - no change from TY 15 HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (estimated)

V1 - dbh (0)	SI = 0.2
V2 - Number trees/acre (0)	SI = 0
V3 - % trees that are oaks (0)	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = .06$$

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = .06

TY 15 - no change from TY 1 HSI = .06

TY 51 - no change from TY 15 HSI = .06

MP 2 - Management Area - Future With Project (Compensation Site)

Assume:
1. Acquire lands (currently annual grasslands)
2. Annual grassland area prepared for planting in TY 1 , provide access and maintenance roads
3. Plant 100% blue and live oak trees (4"x4"x14" tree pots) at a density of 400 trees/acre and cover crop
4. Moderate management intensity (assume 1.5 inches dbh after 10 yrs; 90 percent survival).
5. Watering, weed, pest control for minimum of 3 years and remedial actions as necessary to ensure plant establishment.
6. Assume maximum growth rate of 12"/year
7. Develop O&M manual
8. TY 51 values equal values measured for impact zone

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated) HSI = 0

TY 1 -	V1 - tree species planted /no mast	SI = 0
	V2 - low	SI = 0.2
	V3 - 0 (no trees)	SI = 0
	V4 - 0 (no trees)	SI = 0

HSI = 0

TY 15 -	V1 - oak trees reach 16ft. high 8%	SI = 0.15
	V2 - low	SI = 0.2
	V3 - 8%	SI = 0.15
	V4 - 0	SI = 0

HSI Food = $(V1 \times V2)^{1/2}$
= $(0.15 \times 0.2)^{1/2}$
= .17

HSI Cover/Reproduction = $(V3 \times V4)^{1/2}$
= $(0.15 \times 0)^{1/2}$
= 0

HSI = 0

TY 51	V1 - 40%	SI = 0.8
	V2 - medium	SI = 0.8
	V3 - 53%	SI = 1.0
	V4 - 24/ac	SI = 1.0

HSI Food = $(V1 \times V2)^{1/2}$
= $(0.8 \times 0.2)^{1/2}$
= 0.40

HSI Cover/Reproduction = $(V3 \times V4)^{1/2}$
= $(1.0 \times 1.0)^{1/2}$
= 1.0

HSI = 0.40

TY 0 - Baseline (estimated)

HSI = .06

TY 1 -

V1 - tree species planted (oak) (0 dbh)	SI = 0.2
V2 - 400 (100% $\leq$ 16 ft tall; no trees)	SI = 0
V3 - 100% (no trees)	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = 0.06$$

TY 15 -

V1 - oak trees reach 16 ft. high (dbh = 1.75)	SI = 0.2
V2 - $\geq$ 100 tree/ac	SI = 1.0
V3 - 100%	SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = 0.73$$

TY 51 -

V1 - 2.5 dbh	SI = 0.2
V2 - $\geq$ 100 tree/ac	SI = 1.0
V3 - 100%	SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = 0.73$$

PA 1 - Future Without Project (Impact Area)

SEASONAL WETLAND

GREAT EGRET

TY 0 – Baseline (measured)

V1 - % area with water 4-9 inches deep
V2 - % of substrate in zone 4-9 inches deep with sub- and emergent vegetation

$$HSI = \frac{V1 + V2}{2} = 0.23$$

TY 1 – no change from baseline

HSI = 0.23

TY 51 – no change from baseline

HSI = 0.23

RED-WINGED BLACKBIRD

TY 0 – Baseline (measured)

V6 quality of foraging areas within 620 feet of suitable nest areas

Condition C wetland $HSI = (0.1 \times V6)^{1/2} = 0.2$

TY 1 – no change from baseline

HSI = 0.2

TY 51 – no change from baseline

HSI = 0.2

CALIFORNIA VOLE

TY 0 – Baseline (measured)

V1 – Height herbaceous vegetation
V2 - % herbaceous cover
V3 – Soil type

$$HSI = \frac{V1 + V2 + V3}{3} = 0.76$$

TY 1 – no change from baseline

HSI = 0.76

TY 51 – no change from baseline

HSI = 0.76

PA 2 - Future With Project (Impact Area)

Assume: 1. All vegetation removed from temporary and permanent impact zones in year 1
2. temporary easement areas will not be replanted with woody vegetation
3. existing drainages culverted under roads

GREAT EGRET

TY 0 – Baseline (measured)

V1 - % area with water 4-9 inches deep
V2 - % of substrate in zone 4-9 inches deep with sub- and emergent vegetation

$$HSI = \frac{V1 + V2}{2} = 0.23$$

TY 1 – V1 – 0 SI = 0
V2 - 0 SI = 0.1

$$HSI = \frac{0 + 0.1}{2} = 0.05$$

TY 51 – no change from TY 1

HSI = 0.05

RED-WINGED BLACKBIRD

TY 0 – Baseline (measured)

V6 quality of foraging areas within 620 feet of suitable nest areas

Condition C wetland $HSI = (0.1 \times V6)^{1/2} = 0.2$

TY 1 – no change from baseline

HSI = 0

TY 51 – no change from baseline TY 1

HSI = 0

CALIFORNIA VOLE

TY 0 – Baseline (measured)

V1 – Height herbaceous vegetation
V2 - % herbaceous cover
V3 – Soil type

$$HSI = \frac{V1 + V2 + V3}{3} = 0.76$$

TY 1 –

V1 – 0	SI = 0
V2 – 0	SI = 0
V3 – not silty or loamy ; not friable	SI = 0.2

$$HSI = \frac{0 + 0 + 0.2}{3} = 0.06$$

TY 51 – no change from TY 1

HSI = 0.06

MP 1 - Future Without Project (Compensation Area)

Assumption: 1. Annual grassland area will be converted to wetlands

GREAT EGRET

TY 0 - Baseline (measured)

V1 - % of area with water 4-9 inches deep (0)	SI = 0
V2 - % of area 4-9 deep with emergent/submergent vegetation (0)	SI = .1

$$HSI = \frac{V1 + V2}{2} = \frac{0 + 0.1}{2} = .05$$

TY 1 no change from TY 0

TY 4 no change from TY 1

TY 51 no change from TY 4

CALIFORNIA VOLE

TY 0 - Baseline (estimated)

V1 - Height of herbaceous vegetation (≥ 6in.)	SI = 1.0
V2 - % cover of herbaceous vegetation (80%)	SI = 6.7
V3 - soil type (mod. friable)	SI = 0.5

TY 1 - V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{1.0 + 0.7 + 0.5}{3} = .73$$

TY 4 - V1 - no change from TY 1

TY 51 - V1 - no change from TY 4

RED-WINGED BLACKBIRD

TY 0 - Baseline (estimated) - upland area unsuitable for species HSI = 0

TY 1 - no change from TY 0

TY 4 - no change from TY 1

TY 51 - no change from TY 4

MP 2 - Future With Project (Compensation Site)

Assumption:
1. Acquire annual grassland area
2. Portion of wetland area will have permanent water
3. Wetland will be designed to provide equal mix of open water and emergent vegetation
4. Carp will not be stocked
5. Site baseline is a Condition C wetland.
6. Site is minimum of 1-acre in size and access and maintenance roads are provided.
7. 40% of area designed for summer conditions of water 4-9 in deep
8. Plant appropriate wetland plant species, provide pest control and maintenance as needed for minimum of 3 years or until wetland is established.
9. Cover crop planted on all disturbed non-wetland areas.

GREAT EGRET

TY 0 - Baseline (estimated)

V1 - % of area with water 4-9 inches deep (0)	SI = 0
V2 - % of area with water 4-9 deep with emergent/submergent vegetation	SI = 0.1

$$HSI = \frac{V1 + V2}{2} = \frac{0 + 0.1}{2} = .05$$

TY 1 -

V1 - 40%	SI = 0.4
V2 - 5%	SI = 0.2

$$HSI = \frac{0.4 + 0.2}{2} = \frac{0.6}{2} = .30$$

TY 4 -

V1 - 40%	SI = 0.4
V2 - 40% - 60%	SI = 1.0

$$HSI = \frac{0.4 + 1.0}{2} = .70$$

TY 51 - no change from TY 4

HSI = .70

CALIFORNIA VOLE

TY 0 - Baseline (estimated)

V1 - Height of herbaceous vegetation (≥ 6 in.)	SI = 1.0
V2 - % cover of herbaceous vegetation (80%)	SI = 0.7
V3 - soil type (mod friable)	SI = 0.5

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{1.0 + 0.7 + 0.5}{3} = .73$$

TY 1 - V1 - ≥ 6 in SI = 1.0
V2 - 90% SI = 0.85
V3 - no change fro baseline SI = 0.5

$$HSI = \frac{1.0 + 0.85 + 0.5}{3} = .78$$

TY 4 - V1 - no change from TY 1 SI = 1.0
V2 - 100% SI = 0
V3 - no change from TY 1 SI = 0.5

$$HSI = \frac{1.0 + 0.85 + 0.5}{3} = .78$$

TY 51- V1 - no change from TY 4
V2 - no change from TY 4
V3 - no change from TY 4

HSI = .78

RED-WINGED BLACKBIRD

TY 0 - Baseline (estimated) - upland area unsuitable for species

HSI = 0

TY 1 -	V1 - Emergent vegetation is old/new growth monocot (other)	SI = 0.1
	V2 - Water present throughout year (yes)	SI = 1.0
	V3 - Carp presence (absent)	SI = 1.0
	V4 - larvae of dragonflies/damselflies presence (yes)	SI = 1.0
	V5 - vegetation density (sparse first year)	SI = 0.1

$HSI = (V1 + V2 + V3 + V4 + V5)^{1/5} = (0.1 \times 1.0 \times 1.0 \times 1.0 \times 0.1)^{1/5} = 0.1$

TY 4 -	V1 - old/new growth monocots	SI = 1.0
	V2 - no change	SI = 1.0
	V3 - no change	SI = 1.0
	V4 - no change	SI = 1.0
	V5 - 50%	SI = 1.0

$HSI = (1.0 \times 1.0 \times 1.0 \times 1.0 \times 1.0)^{1/5} = 1.0$

TY 51 - no change from TY 4

HSI = 1.0

REACH 2 - PARKING LOT NEAR SOUTH END OF DAM TO FOLSOM PRISON ACCESS ROAD

PA 1 - Future Without Project (Impact Area)

OAK WOODLAND

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured)
V1 - % canopy closure of trees and shrubs that produce hard mast
V2 - Density of leaf litter layer
V3 - % tree cover
V4 - Den site availability

HSI Food $= (V1 \times V2)^{1/2}$ HSI Cover/Reproduction $= (V3 \times V4)^{1/2}$

HSI = 0.48 (lowest of values)

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0

HSI = 0.48

TY 51
V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1

HSI = 0.48

PLAIN TITMOUSE

TY 0 - Baseline (measured)
V1 - dbh
V2 - Number trees/acre
V3 - % trees that are oaks

$$HSI = \frac{V1 + V2 + V3}{3}$$

HSI = 0 .65

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = 0.65

TY 51 — V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = 0.65

PA 2 - Future With Project (Impact Area)

Assume:
1. All vegetation removed from temporary and permanent impact zones in year 1
2. temporary easement areas will not be replanted with woody vegetation

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured) — HSI = 0.48

TY 1 -

V1 - no trees	SI = 0
V2 - low leaf litter	SI = 0.2
V3 - no trees	SI = 0
V4 - no den sites	SI = 0

HSI Food $= (V1 \times V2)^{½} = (0 \times 0.2)^{½} = 0$

HSI Cover/Reproduction $= (V3 \times V4)^{½} = (0 \times 0)^{½} = 0$

HSI = 0

TY 51- V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1

HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (measured) — HSI = 0.65

TY 1 -

V1 - no trees	SI = 0.2
V2 - no trees	SI = 0
V3 - no trees	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2}{3} = 0.06$$

TY 51 - V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1

HSI = .06

MP 1 - Management Area - Future Without Project (Compensation Site)

Assume: 1. Annual grassland area selected for conversion to oak woodland.

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated)

V1 - % canopy closure of trees and shrubs that produce hard mast (no trees) SI = 0
V2 - Density of leaf litter (low) SI = 0.2
V3 - Den site availability (no trees) SI = 0

HSI Food = $(V1 \times V2)^{1/2}$
= $(0 \times 0.2)^{1/2}$
= 0

HSI Cover/Reproduction = $(V3 \times V4)^{1/2}$
= $(0 \times 0)^{1/2}$
= 0

HSI = 0

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0

HSI = 0

TY 15 - no change from TY 1 HSI = 0

TY 51 - no change from TY 15 HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (estimated)

V1 - dbh (0) SI = 0.2
V2 - Number trees/acre (0) SI = 0
V3 - % trees that are oaks (0) SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = .06$$

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = .06

TY 15 - no change from TY 1 HSI = .06

TY 100 - no change from TY 15 HSI = .06

MP 2 - Management Area - Future With Project (Compensation Site)

Assume:

1. Acquire lands (currently annual grasslands)
2. Annual grassland area prepared for planting in TY 1 , provide access and maintenance roads
3. Plant 100% blue and live oak trees (4"x4"x14" tree pots) at a density of 400 trees/acre and cover crop
4. Moderate management intensity (assume 1.5 inches dbh after 10 yrs; 90 percent survival).
5. Watering, weed, pest control for minimum of 3 years and remedial actions as necessary to ensure plant establishment.
6. Assume maximum growth rate of 12"/year
7. Develop O&M manual
8. TY 51 values equal values measured for impact zone

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated) HSI = 0

TY 1 -	V1 - tree species planted /no mast	SI = 0
	V2 - low	SI = 0.2
	V3 - 0 (no trees)	SI = 0
	V4 - 0 (no trees)	SI = 0

HSI = 0

TY 15 -	V1 - oak trees reach 16ft. high 8%	SI = 0.15
	V2 - low	SI = 0.2
	V3 - 8%	SI = 0.15
	V4 - 0	SI = 0

HSI Food $= (V1 \times V2)^{1/2}$
$= (0.15 \times 0.2)^{1/2}$
$= .17$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2}$
$= (0.15 \times 0)^{1/2}$
$= 0$

HSI = 0

TY 51	V1 - 40%	SI = 0.8
	V2 - medium	SI = 0.8
	V3 - 53%	SI = 1.0
	V4 - 24/ac	SI = 1.0

HSI Food $= (V1 \times V2)^{1/2}$
$= (0.8 \times 0.2)^{1/2}$
$= 0.40$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2}$
$= (1.0 \times 1.0)^{1/2}$
$= 1.0$

HSI = 0.40

TY 0 - Baseline (estimated)

HSI = .06

TY 1 -	V1 - tree species planted (oak) (0 dbh)	SI = 0.2
	V2 - 400 (100% ≤ 16 ft tall; no trees)	SI = 0
	V3 - 100% (no trees)	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = 0.06$$

TY 15 -	V1 - oak trees reach 16 ft. high (dbh = 1.75)	SI = 0.2
	V2 - ≥ 100 tree/ac	SI = 1.0
	V3 - 100%	SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = 0.73$$

TY 51 -	V1 - 2.5 dbh	SI = 0.2
	V2 - ≥ 100 tree/ac	SI = 1.0
	V3 - 100%	SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = 0.73$$

PA 1 - Future Without Project (Impact Area)

SEASONAL WETLAND

GREAT EGRET

TY 0 – Baseline (measured)

V1 - % area with water 4-9 inches deep
V2 - % of substrate in zone 4-9 inches deep with sub- and emergent vegetation

$$HSI = \frac{V1 + V2}{2} = 0.23$$

TY 1 – no change from baseline

HSI = 0.23

TY 51 – no change from baseline

HSI = 0.23

RED-WINGED BLACKBIRD

TY 0 – Baseline (measured)

V6 quality of foraging areas within 620 feet of suitable nest areas

Condition C wetland $HSI = (0.1 \times V6)^{1/2} = 0.2$

TY 1 – no change from baseline

HSI = 0.2

TY 51 – no change from baseline

HSI = 0.2

CALIFORNIA VOLE

TY 0 – Baseline (measured)

V1 – Height herbaceous vegetation
V2 - % herbaceous cover
V3 – Soil type

$$HSI = \frac{V1 + V2 + V3}{3} = 0.76$$

TY 1 – no change from baseline

HSI = 0.76

TY 51 – no change from baseline

HSI = 0.76

PA 2 - Future With Project (Impact Area)

Assume: 1. All vegetation removed from temporary and permanent impact zones in year 1
2. temporary easement areas will not be replanted with woody vegetation
3. existing drainages culverted under roads

GREAT EGRET

TY 0 – Baseline (measured)

V1 - % area with water 4-9 inches deep
V2 - % of substrate in zone 4-9 inches deep with sub- and emergent vegetation

$$HSI = \frac{V1 + V2}{2} = 0.23$$

TY 1 – V1 – 0 SI = 0
V2 - 0 SI = 0.1

$$HSI = \frac{0 + 0.1}{2} = 0.05$$

TY 51 – no change from TY 1

HSI = 0.05

RED-WINGED BLACKBIRD

TY 0 – Baseline (measured)

V6 quality of foraging areas within 620 feet of suitablenest areas

Condition C wetland $HSI = (0.1 \times V6)^{1/2} = 0.2$

TY 1 – no change from baseline

HSI = 0

TY 51 – no change from baseline TY 1

HSI = 0

CALIFORNIA VOLE

TY 0 – Baseline (measured)

V1 – Height herbaceous vegetation
V2 - % herbaceous cover
V3 – Soil type

$$HSI = \frac{V1 + V2 + V3}{3} = 0.76$$

TY 1 – V1 – 0 SI = 0
V2 – 0 SI = 0
V3 – not silty or loamy ; not friable SI = 0.2

$$HSI = \frac{0 + 0 + 0.2}{3} = 0.06$$

TY 51 – no change from TY 1

HSI = 0.06

MP 1 - Future Without Project (Compensation Area)

Assumption: 1. Annual grassland area will be converted to wetlands

GREAT EGRET

TY 0 - Baseline (measured)
V1 - % of area with water 4-9 inches deep (0) SI = 0
V2 - % of area 4-9 deep with emergent/submergent vegetation (0) SI = .1

$$HSI = \frac{V1 + V2}{2} = \frac{0 + 0.1}{2} = .05$$

TY 1 no change from TY 0

TY 4 no change from TY 1

TY 51 no change from TY 4

CALIFORNIA VOLE

TY 0 - Baseline (estimated)
V1 - Height of herbaceous vegetation (≥ 6in.) SI = 1.0
V2 - % cover of herbaceous vegetation (80%) SI = 6.7
V3 - soil type (mod. friable) SI = 0.5

TY 1 - V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{1.0 + 0.7 + 0.5}{3} = .73$$

TY 4 - V1 - no change from TY 1

TY 51 - V1 - no change from TY 4

RED-WINGED BLACKBIRD

TY 0 - Baseline (estimated) - upland area unsuitable for species HSI = 0

TY 1 - no change from TY 0

TY 4 - no change from TY 1

TY 51 - no change from TY 4

MP 2 - Future With Project (Compensation Site)

Assumption:

1. Acquire annual grassland area
2. Portion of wetland area will have permanent water
3. Wetland will be designed to provide equal mix of open water and emergent vegetation
4. Carp will not be stocked
5. Site baseline is a Condition C wetland.
6. Site is minimum of 1-acre in size and access and maintenance roads are provided.
7. 40% of area designed for summer conditions of water 4-9 in deep
8. Plant appropriate wetland plant species, provide pest control and maintenance as needed for minimum of 3 years or until wetland is established.
9. Cover crop planted on all disturbed non-wetland areas.

GREAT EGRET

TY 0 - Baseline (estimated)
V1 - % of area with water 4-9 inches deep (0) SI = 0
V2 - % of area with water 4-9 deep with emergent/submergent vegetation SI = 0.1

$$HSI = \frac{V1 + V2}{2} = \frac{0 + 0.1}{2} = .05$$

TY 1 - V1 - 40% SI = 0.4
V2 - 5% SI = 0.2

$$HSI = \frac{0.4 + 0.2}{2} = \frac{0.6}{2} = .30$$

TY 4 - V1 - 40% SI = 0.4
V2 - 40% - 60% SI = 1.0

$$HSI = \frac{0.4 + 1.0}{2} = .70$$

TY 51 - no change from TY 4

HSI = .70

CALIFORNIA VOLE

TY 0 - Baseline (estimated)

V1 - Height of herbaceous vegetation ($\geq$ 6 in.)	SI = 1.0
V2 - % cover of herbaceous vegetation (80%)	SI = 0.7
V3 - soil type (mod friable)	SI = 0.5

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{1.0 + 0.7 + 0.5}{3} = .73$$

TY 1 - V1 - $\geq$ 6 in SI = 1.0
V2 - 90% SI = 0.85
V3 - no change fro baseline SI = 0.5

$$HSI = \frac{1.0 + 0.85 + 0.5}{3} = .78$$

TY 4 - V1 - no change from TY 1 SI = 1.0
V2 - 100% SI = 0
V3 - no change from TY 1 SI = 0.5

$$HSI = \frac{1.0 + 0.85 + 0.5}{3} = .78$$

TY 51- V1 - no change from TY 4
V2 - no change from TY 4
V3 - no change from TY 4

HSI = .78

TY 0 - Baseline (estimated) - upland area unsuitable for species

HSI = 0

TY 1 -	V1 - Emergent vegetation is old/new growth monocot (other)	SI = 0.1
	V2 - Water present throughout year (yes)	SI = 1.0
	V3 - Carp presence (absent)	SI = 1.0
	V4 - larvae of dragonflies/damselflies presence (yes)	SI = 1.0
	V5 - vegetation density (sparse first year)	SI = 0.1

$$HSI = (V1 + V2 + V3 + V4 + V5)^{1/2} = (0.1 \times 1.0 \times 1.0 \times 1.0 \times 0.1)^{1/2} = 0.1$$

TY 4 -	V1 - old/new growth monocots	SI = 1.0
	V2 - no change	SI = 1.0
	V3 - no change	SI = 1.0
	V4 - no change	SI = 1.0
	V5 - 50%	SI = 1.0

$$HSI = (1.0 \times 1.0 \times 1.0 \times 1.0 \times 1.0)^{1/2} = 1.0$$

TY 51 - no change from TY 4

HSI = 1.0

PA 1 - Future Without Project (Impact Area)

RIPARIAN

YELLOW WARBLER

TY 0 – Baseline (measured)

V1 - % deciduous shrub crown cover (0%)	SI = 0
V2 - average height of deciduous shrub canopy (7 ft)	SI = 1.0
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (0%)	SI = 0.1

HSI = $(V1 \times V2 \times V3)^{1/3} = (0 \times 1.0 \times 0.1)^{1/2} = 0$

TY 1 – no change from baseline

HSI = 0

TY 51 – V1 – 10%	SI = 0.17
V2 – 7 ft	SI = 1.0
V3 – 75%	SI = 0.68

HSI = $(0.17 \times 1.0 \times 0.68)^{1/3} = 0.49$

NORTHERN ORIOLE

TY 0 – Baseline (measured)

V1 - average height of deciduous tree canopy (47 ft)	SI = 1.0
V2 - % deciduous tree crown cover (90-100%)	SI = 0.8
V3 – stand width (< 300 ft)	SI = 0.5

HSI = $(V1 \times V2 \times V3)^{1/3} = 0.74$

TY 1 – no change from baseline

HSI = 0.74

TY 51 – no change from baseline

HSI = 0.77

WESTERN FENCE LIZARD

TY 0 – Baseline (measured)

V1 - % ground cover (80-100%)	SI = 0.66
V2 - average size of ground cover objects (2 ft)	SI = 0.8
V3 - structural diversity/interspersion (C)	SI = 1.0
V4 - % canopy cover (90 – 100%)	SI = 0

$CI = (2V1 \times V2 \times V3)^{1/3} = (2\ 0.66 \times 0.8 \times 1.0)^{1/3} = 1.0$
$TI = (V1 \times V4)^{1/2} = (0.66 \times 0)^{1/2} = 0$
$HSI = (CI \times TI)^{1/2} = 0$ (average of transects)

TY 1 – no change from baseline

$HSI = 0$

TY 51 – no change from baseline

V1 - % ground cover (80%)	SI = 0.66
V2 - average size of ground cover objects (2 ft)	SI = 0.8
V3 - structural diversity/interspersion (C)	SI = 1.0
V4 - % canopy cover (75%)	SI = 0.3

$CI = (2V1 \times V2 \times V3)^{1/3} = (2\ 0.66 \times 0.8 \times 1.0)^{1/3} = 1.0$

$TI = (V1 \times V4)^{1/2} = (0.66 \times 0.3)^{1/2} = 0.44$

$HSI = (CI \times TI)^{1/2} = 0.66$

PA 2 - Future With Project (Impact Area)

Assume: 1. All vegetation removed from temporary and permanent impact zones in year 1.
2. Temporary easement areas will not be replanted with woody vegetation.

YELLOW WARBLER

TY 0 – Baseline (measured)

V1 - % deciduous shrub crown cover
V2 - average height of deciduous shrub canopy
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 1	– V1 – no shrubs	SI = 0
	V2 – no shrubs	SI = 0
	V3 - no shrubs	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 51	– V1 – no shrubs	SI = 0
	V2 – no shrubs	SI = 0
	V3 - no shrubs	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

NORTHERN ORIOLE

TY 0 – Baseline (measured)

V1 - average height of deciduous tree canopy
V2 - % deciduous tree crown cover
V3 – stand width

HSI = $(V1 \times V2 \times V3)^{1/3}$ = 0.74

TY 1 -	V1 – no trees	SI = 0
	V2 – no trees	SI = 0
	V3 – no trees	SI = 0

HSI = $(V1 \times V2 \times V3)^{1/3}$ = 0

TY 51 –	V1 – no trees	SI = 0
	V2 – no trees	SI = 0
	V3 – no trees	SI = 0

HSI = $(V1 \times V2 \times V3)^{1/3}$ = 0

WESTERN FENCE LIZARD

TY 0 – Baseline (measured)

V1 - % ground cover
V2 - average size of ground cover objects
V3 - structural diversity/interspersion
V4 - % canopy cover

CI = $(2V1 \times V2 \times V3)^{1/3}$

TI = $(V1 \times V4)^{1/2}$

HSI = $(CI \times TI)^{1/2}$ = 0

TY 1 –	V1 – no ground cover	SI = 0
	V2 – no cover objects	SI = 0
	V3 – A	SI = 0.1
	V4 – no canopy cover	SI = 1.0

CI = $(2V1 \times V2 \times V3)^{1/3}$ = 0

TI = $(V1 \times V4)^{1/2}$ = 0

HSI = $(CI \times TI)^{1/2}$ = 0

TY 51 – No change from TY 1

MP 1 – Management Area – Future Without the Project (Compensation Site)

Assume: 1. Existing riparian river bank upstream of Rossmoor Bar can be enhanced by planting riparian species (south side of river).

YELLOW WARBLER

TY 0 – Baseline (measured)

V1 - % deciduous shrub crown cover (0)	SI = 0
V2 - average height of deciduous shrub canopy (5 ft)	SI = 0.82
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (0)	SI = 0

HSI = $(V1 \times V2 \times V3)^{1/3} = 0$

TY 1 – no change from baseline
HSI = 0

TY 15 – no change from baseline
HSI = 0

TY 30 – no change from baseline
HSI = 0

TY 51 – no change from baseline
HSI = 0

NORTHERN ORIOLE

TY 0 – Baseline (measured)

V1 - average height of deciduous tree canopy (27 ft)	SI = 0.77
V2 - % deciduous tree crown cover (0)	SI = 0
V3 – stand width (1)	SI = 0.2

HSI = $(V1 \times V2 \times V3)^{1/3} = 0$

TY 1 – no change from baseline
HSI = 0

TY 15 – no change from baseline
HSI = 0

TY 30 – no change from baseline
HSI = 0

TY 51 – no change from baseline
HSI = 0

WESTERN FENCE LIZARD

TY 0 – Baseline (measured)

V1 - % ground cover (0)	SI = 0
V2 - average size of ground cover objects (< 1 ft)	SI = 0.2
V3 - structural diversity/interspersion (A)	SI = 0.1
V4 - % canopy cover (0)	SI = 1.0

$CI = (2V1 \times V2 \times V3)^{1/3} = 0$

$TI = (V1 \times V4)^{1/2} = 0$

$HSI = (CI \times TI)^{1/2} = 0$

TY 1 – no change from baseline
HSI = 0

TY 15 – no change from baseline
HSI = 0

TY 30 – no change from baseline
HSI = 0

TY 51 – no change from baseline
HSI = 0

MP 2 – Management Area – Future With Project (Compensation Site)

Assume:
1. Acquire lands.
2. Watering, weed and pest management for a minimum of 3 years and remedial actions as necessary to ensure plant establishment.
3. Willow species and cottonwoods (80% of woody plantings will be planted near the mean summer water surface elevation and less water tolerant plants (oaks, etc) will be planted higher on the bank.
4. The site will extend no more than 25 feet up the bank from mean summer water surface elevation.
5. Assume average growth rate of 24 inches/year for willows and cottonwood trees.

YELLOW WARBLER

TY 0 – Baseline (measured)

V1 - % deciduous shrub crown cover (0)	SI = 0
V2 - average height of deciduous shrub canopy (5 ft)	SI = 0.82
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (0)	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 1 – V1 - % deciduous shrub crown cover (5%) SI = 0.15
V2 - average height of deciduous shrub canopy (1 ft) SI = 0.17
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (80%) SI = 0.80

HSI = $(0.15 \times 0.17 \times 0.80)^{1/2}$ = 0.14

TY 15 – V1 - % deciduous shrub crown cover (75%) SI = 1.0
V2 - average height of deciduous shrub canopy (5ft) SI = 0.82
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (80%) SI = 0.80

HSI = $(1.0 \times 0.82 \times 0.80)^{1/2}$ = 0.81

TY 30 – V1 - % deciduous shrub crown cover (75%) SI = 1.0
V2 - average height of deciduous shrub canopy (5ft) SI = 0.82
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (80%) SI = 0.80

HSI = $(1.0 \times 0.82 \times 0.80)^{1/2}$ = 0.81

TY 51 – no change from TY 30

NORTHERN ORIOLE

TY 0 – Baseline (measured)

V1 - average height of deciduous tree canopy (27 ft) SI = 0.77
V2 - % deciduous tree crown cover (0) SI = 0
V3 – stand width (1) SI = 0.2

HSI = $(V1 \times V2 \times V3)^{1/3}$ = 0

TY 1 – V1 - average height of deciduous tree canopy (27 ft) SI = 0.77
V2 - % deciduous tree crown cover (0) SI = 0
V3 – stand width (< 300 ft) SI = 0.5

HSI = $(V1 \times V2 \times V3)^{1/3}$ = 0

TY 15 – V1 - average height of deciduous tree canopy (16 ft) SI = 0.77
V2 - % deciduous tree crown cover (25%) SI = 1.0
V3 – stand width (< 300 ft) SI = 0.5

HSI = $(0.77 \times 1.0 \times 0.5)^{1/3}$ = 0.54

TY 30 – V1 - average height of deciduous tree canopy (40 ft) SI = 1.0
V2 - % deciduous tree crown cover (50%) SI = 1.0
V3 – stand width (< 300 ft) SI = 0.5

HSI = $(1.0 \times 1.0 \times 0.5)^{1/3}$ = 0.79

TY 51 - V1 - average height of deciduous tree canopy (80 ft) SI = 1.0
V2 - % deciduous tree crown cover (75%) SI = 0.9
V3 – stand width (< 300 ft) SI = 0.5

HSI = $(1.0 \times 0.9 \times 0.5)^{1/3}$ = 0.77

WESTERN FENCE LIZARD

TY 0 – Baseline (measured)

V1 - % ground cover (0) SI = 0
V2 - average size of ground cover objects (< 1 ft) SI = 0.2
V3 - structural diversity/interspersion (A) SI = 0.1
V4 - % canopy cover (0) SI = 1.0

CI = $(2V1 \times V2 \times V3)^{1/3}$ = 0

TI = $(V1 \times V4)^{1/2}$ = 0

HSI = $(CI \times TI)^{1/2}$ = 0

TY 1 – V1 - % ground cover (0) SI = 0
V2 - average size of ground cover objects (< 1 ft) SI = 0.2
V3 - structural diversity/interspersion (A) SI = 0.1
V4 - % canopy cover (0) SI = 1.0

CI = $(2V1 \times V2 \times V3)^{1/3}$ = 0

TI = $(V1 \times V4)^{1/2}$ = 0

HSI = $(CI \times TI)^{1/2}$ = 0

TY 15 – V1 - % ground cover (5%) SI = 0
V2 - average size of ground cover objects (≤ 1 ft) SI = 0.2
V3 - structural diversity/interspersion (A) SI = 0.1
V4 - % canopy cover (40%) SI = 1.0

CI = $(2V1 \times V2 \times V3)^{1/3}$ = 0

TI = $(V1 \times V4)^{1/2}$ = 0

HSI = $(CI \times TI)^{1/2}$ = 0

TY 30 – V1 - % ground cover (25%) — SI = 1.0
V2 - average size of ground cover objects (2 ft) — SI = 0.8
V3 - structural diversity/interspersion (C) — SI = 1.0
V4 - % canopy cover (75%) — SI = 0.33

$CI = (2V1 \times V2 \times V3)^{1/3} = 1.16\ (1.0)$

$TI = (V1 \times V4)^{1/2} = 0.57$

$HSI = (CI \times TI)^{1/2} = 0.75$

TY 51 – V1 - % ground cover (50%) — SI = 1.0
V2 - average size of ground cover objects (2 ft) — SI = 0.8
V3 - structural diversity/interspersion (C) — SI = 1.0
V4 - % canopy cover (75%) — SI = 0.33

$CI = (2V1 \times V2 \times V3)^{1/3} = 1.16\ (1.0)$

$TI = (V1 \times V4)^{1/2} = 0.57$

$HSI = (CI \times TI)^{1/2} = 0.75$

REACH 3 - FOLSOM PRISON ACCESS ROAD TO SOUTH END OF BRIDGE

PA 1 - Future Without Project (Impact Area)

OAK WOODLAND

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured)
V1 - % canopy closure of trees and shrubs that produce hard mast
V2 - Density of leaf litter layer
V3 - % tree cover
V4 - Den site availability

HSI Food $= (V1 \times V2)^{1/2}$ HSI Cover/Reproduction $= (V3 \times V4)^{1/2}$

HSI = 0.48 (lowest of values)

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0

HSI = 0.48

TY 51
V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1

HSI = 0.48

PLAIN TITMOUSE

TY 0 - Baseline (measured)
V1 - dbh
V2 - Number trees/acre
V3 - % trees that are oaks

$$HSI = \frac{V1 + V2 + V3}{3}$$

HSI = 0 .65

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = 0.65

TY 51 V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = 0.65

PA 2 - Future With Project (Impact Area)

Assume: 1. All vegetation removed from temporary and permanent impact zones in year 1
2. temporary easement areas will not be replanted with woody vegetation

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured) HSI = 0.48

TY 1 -

V1 - no trees		SI = 0
V2 - low leaf litter		SI = 0.2
V3 - no trees		SI = 0
V4 - no den sites		SI = 0

HSI Food = $(V1 \times V2)^{½}$
= $(0 \times 0.2)^{½}$
= 0

HSI Cover/Reproduction = $(V3 \times V4)^{½}$
= $(0 \times 0)^{½}$
= 0

HSI = 0

TY 51- V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1

HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (measured) HSI = 0.65

TY 1 -

V1 - no trees		SI = 0.2
V2 - no trees		SI = 0
V3 - no trees		SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2}{3} = 0.06$$

TY 51 - V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1

HSI = .06

MP 1 - Management Area - Future Without Project (Compensation Site)

Assume: 1. Annual grassland area selected for conversion to oak woodland.

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated)

V1 - % canopy closure of trees and shrubs that produce hard mast (no trees)	SI = 0
V2 - Density of leaf litter (low)	SI = 0.2
V3 - Den site availability (no trees)	SI = 0

HSI Food $= (V1 \times V2)^{1/2} = (0 \times 0.2)^{1/2} = 0$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = (0 \times 0)^{1/2} = 0$

HSI = 0

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0

HSI = 0

TY 15 - no change from TY 1 HSI = 0

TY 51 - no change from TY 30 HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (estimated)

V1 - dbh (0)	SI = 0.2
V2 - Number trees/acre (0)	SI = 0
V3 - % trees that are oaks (0)	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = .06$$

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = .06

TY 15 - no change from TY 1 HSI = .06

TY 51 - no change from TY 30 HSI = .06

MP 2 - Management Area - Future With Project (Compensation Site)

Assume:

1. Acquire lands (currently annual grasslands)
2. Annual grassland area prepared for planting in TY 1 , provide access and maintenance roads
3. Plant 100% blue and live oak trees (4"x4"x14" tree pots) at a density of 400 trees/acre and cover crop
4. Moderate management intensity (assume 1.5 inches dbh after 10 yrs; 90 percent survival).
5. Watering, weed, pest control for minimum of 3 years and remedial actions as necessary to ensure plant establishment.
6. Assume maximum growth rate of 12"/year
7. Develop O&M manual
8. TY 51 values equal values measured for impact zone

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated) HSI = 0

TY 1 -

V1 - tree species planted /no mast	SI = 0
V2 - low	SI = 0.2
V3 - 0 (no trees)	SI = 0
V4 - 0 (no trees)	SI = 0

HSI = 0

TY 15 -

V1 - oak trees reach 16ft. high 8%	SI = 0.15
V2 - low	SI = 0.2
V3 - 8%	SI = 0.15
V4 - 0	SI = 0

HSI Food $= (V1 \times V2)^{1/2} = (0.15 \times 0.2)^{1/2} = .17$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = (0.15 \times 0)^{1/2} = 0$

HSI = 0

TY 51

V1 - 40%	SI = 0.8
V2 - medium	SI = 0.8
V3 - 53%	SI = 1.0
V4 - 24/ac	SI = 1.0

HSI Food $= (V1 \times V2)^{1/2} = (0.8 \times 0.2)^{1/2} = 0.40$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = (1.0 \times 1.0)^{1/2} = 1.0$

HSI = 0.40

PLAIN TITMOUSE

TY 0 - Baseline (estimated)

HSI = .06

TY 1 -

V1 - tree species planted (oak) (0 dbh) SI = 0.2
V2 - 400 (100% $\leq$ 16 ft tall; no trees) SI = 0
V3 - 100% (no trees) SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = 0 .06$$

TY 15 -

V1 - oak trees reach 16 ft. high (dbh = 1.75) SI = 0.2
V2 - $\geq$ 100 tree/ac SI = 1.0
V3 - 100% SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = 0.73$$

TY 51 -

V1 - 2.5 dbh SI = 0.2
V2 - $\geq$ 100 tree/ac SI = 1.0
V3 - 100% SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = 0 .73$$

RIPARIAN

YELLOW WARBLER

TY 0 – Baseline (measured)

V1 - % deciduous shrub crown cover
V2 - average height of deciduous shrub canopy
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs

$$HSI = (V1 \times V2 \times V3)^{1/3}$$

TY 1 – no change from baseline

HSI = 0.22

TY 51 – no change from baseline

HSI = 0.22

NORTHERN ORIOLE

TY 0 – Baseline (measured)

V1 - average height of deciduous tree canopy
V2 - % deciduous tree crown cover
V3 – stand width

$HSI = (V1 \times V2 \times V3)^{1/3}$

TY 1 – no change from baseline

HSI = 0.77

TY 51 – no change from baseline

HSI = 0.77

WESTERN FENCE LIZARD

TY 0 – Baseline (measured)

V1 - % ground cover
V2 - average size of ground cover objects
V3 - structural diversity/interspersion
V4 - % canopy cover

$CI = (2V1 \times V2 \times V3)^{1/3}$
$TI = (V1 \times V4)^{1/2}$

$HSI = (CI \times TI)^{1/2} = 0.63$ (average of transects)

TY 1 – no change from baseline

HSI = 0.63

TY 51 – no change from baseline

HSI = 0.63

PA 2 - Future With Project (Impact Area)

Assume: 1. All vegetation removed from temporary and permanent impact zones in year 1.
2. Temporary easement areas will not be replanted with woody vegetation.

YELLOW WARBLER

TY 0 – Baseline (measured)

V1 - % deciduous shrub crown cover
V2 - average height of deciduous shrub canopy
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs

$HSI = (V1 \times V2 \times V3)^{1/3}$

TY 1 –	V1 – no shrubs	SI = 0
	V2 – no shrubs	SI = 0
	V3 - no shrubs	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 51 –	V1 – no shrubs	SI = 0
	V2 – no shrubs	SI = 0
	V3 - no shrubs	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

NORTHERN ORIOLE

TY 0 – Baseline (measured)

V1 - average height of deciduous tree canopy
V2 - % deciduous tree crown cover
V3 – stand width

$HSI = (V1 \times V2 \times V3)^{1/3}$

TY 1 -	V1 – no trees	SI = 0
	V2 – no trees	SI = 0
	V3 – no trees	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 51 –	V1 – no trees	SI = 0
	V2 – no trees	SI = 0
	V3 – no trees	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 0 – Baseline (measured)

V1 - % ground cover
V2 - average size of ground cover objects
V3 - structural diversity/interspersion
V4 - % canopy cover

$CI = (2V1 \times V2 \times V3)^{1/3}$

$TI = (V1 \times V4)^{1/2}$

$HSI = (CI \times TI)^{1/2} = 0.63$ (average of transects)

TY 1 –	V1 – no ground cover	SI = 0
	V2 – no cover objects	SI = 0
	V3 – A	SI = 0.1
	V4 – no canopy cover	SI = 1.0

$CI = (2V1 \times V2 \times V3)^{1/3} = 0$

$TI = (V1 \times V4)^{1/2} = 0$

$HSI = (CI \times TI)^{1/2} = 0$

TY 51 – No change from TY 1

MP 1 – Management Area – Future Without the Project (Compensation Site)

Assume: 1. Existing riparian river bank upstream of Rossmoor Bar can be enhanced by planting riparian species (south side of river).

YELLOW WARBLER

TY 0 – Baseline (measured)

V1 - % deciduous shrub crown cover (0)	SI = 0
V2 - average height of deciduous shrub canopy (5 ft)	SI = 0.82
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (0)	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 1 – no change from baseline

HSI = 0

TY 15 – no change from baseline

HSI = 0

TY 30 – no change from baseline

HSI = 0

TY 51 – no change from baseline

HSI = 0

NORTHERN ORIOLE

TY 0 – Baseline (measured)

V1 - average height of deciduous tree canopy (27 ft)	SI = 0.77
V2 - % deciduous tree crown cover (0)	SI = 0
V3 – stand width (1)	SI = 0.2

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 1 – no change from baseline

HSI = 0

TY 15 – no change from baseline

HSI = 0

TY 30 – no change from baseline

HSI = 0

TY 51 – no change from baseline

HSI = 0

WESTERN FENCE LIZARD

TY 0 – Baseline (measured)

V1 - % ground cover (0)	SI = 0
V2 - average size of ground cover objects (< 1 ft)	SI = 0.2
V3 - structural diversity/interspersion (A)	SI = 0.1
V4 - % canopy cover (0)	SI = 1.0

$CI = (2V1 \times V2 \times V3)^{1/3} = 0$

$TI = (V1 \times V4)^{1/2} = 0$

$HSI = (CI \times TI)^{1/2} = 0$

TY 1 – no change from baseline

HSI = 0

TY 15 – no change from baseline

HSI = 0

TY 30 – no change from baseline

HSI = 0

TY 51 – no change from baseline

HSI = 0

MP 2 – Management Area – Future With Project (Compensation Site)

Assume:
1. Acquire lands.
2. Watering, weed and pest management for a minimum of 3 years and remedial actions as necessary to ensure plant establishment.
3. Willow species and cottonwoods (80% of woody plantings will be planted near the mean summer water surface elevation and less water tolerant plants (oaks, etc) will be planted higher on the bank.
4. The site will extend no more than 25 feet up the bank from mean summer water surface elevaion
5. Assume average growth rate of 24 inches/year for willows and cottonwood trees..

YELLOW WARBLER

TY 0 – Baseline (measured)

V1 - % deciduous shrub crown cover (0)	SI = 0
V2 - average height of deciduous shrub canopy (5 ft)	SI = 0.82
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (0)	SI = 0

HSI = $(V1 \times V2 \times V3)^{1/3} = 0$

TY 1 – V1 - % deciduous shrub crown cover (5%)	SI = 0.15
V2 - average height of deciduous shrub canopy (1 ft)	SI = 0.17
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (80%)	SI = 0.80

HSI = $(0.15 \times 0.17 \times 0.80)^{1/2} = 0.14$

TY 15 – V1 - % deciduous shrub crown cover (75%)	SI = 1.0
V2 - average height of deciduous shrub canopy (5ft)	SI = 0.82
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (80%)	SI = 0.80

HSI = $(1.0 \times 0.82 \times 0.80)^{1/2} = 0.81$

TY 30 – V1 - % deciduous shrub crown cover (75%)	SI = 1.0
V2 - average height of deciduous shrub canopy (5ft)	SI = 0.82
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (80%)	SI = 0.80

HSI = $(1.0 \times 0.82 \times 0.80)^{1/2} = 0.81$

TY 51 – no change from TY 30

NORTHERN ORIOLE

TY 0 – Baseline (measured)

V1 - average height of deciduous tree canopy (27 ft)	SI = 0.77
V2 - % deciduous tree crown cover (0)	SI = 0
V3 – stand width (1)	SI = 0.2

HSI = $(V1 \times V2 \times V3)^{1/3} = 0$

TY 1 – V1 - average height of deciduous tree canopy (27 ft) SI = 0.77
V2 - % deciduous tree crown cover (0) SI = 0
V3 – stand width (< 300 ft) SI = 0.5

HSI = (V1 x V2 x V3)$^{1/3}$ = 0

TY 15 – V1 - average height of deciduous tree canopy (16 ft) SI = 0.77
V2 - % deciduous tree crown cover (25%) SI = 1.0
V3 – stand width (< 300 ft) SI = 0.5

HSI = (0.77 x 1.0 x 0.5)$^{1/3}$ = 0.54

TY 30 – V1 - average height of deciduous tree canopy (40 ft) SI = 1.0
V2 - % deciduous tree crown cover (50%) SI = 1.0
V3 – stand width (< 300 ft) SI = 0.5

HSI = (1.0 x 1.0 x 0.5)$^{1/3}$ = 0.79

TY 51 - V1 - average height of deciduous tree canopy (>40 ft) SI = 1.0
V2 - % deciduous tree crown cover (75%) SI = 0.9
V3 – stand width (< 300 ft) SI = 0.5

HSI = (1.0 x 0.9 x 0.5)$^{1/3}$ = 0.77

WESTERN FENCE LIZARD

TY 0 – Baseline (measured)

V1 - % ground cover (0) SI = 0
V2 - average size of ground cover objects (< 1 ft) SI = 0.2
V3 - structural diversity/interspersion (A) SI = 0.1
V4 - % canopy cover (0) SI = 1.0

CI = (2V1 x V2 x V3)$^{1/3}$ = 0

TI = (V1 x V4)$^{1/2}$ = 0

HSI = (CI x TI)$^{1/2}$ = 0

TY 1 – V1 - % ground cover (0) SI = 0
V2 - average size of ground cover objects (< 1 ft) SI = 0.2
V3 - structural diversity/interspersion (A) SI = 0.1
V4 - % canopy cover (0) SI = 1.0

CI = (2V1 x V2 x V3)$^{1/3}$ = 0

TI = (V1 x V4)$^{1/2}$ = 0

HSI = (CI x TI)$^{1/2}$ = 0

TY 15 – V1 - % ground cover (5%) SI = 0
V2 - average size of ground cover objects (≤ 1 ft) SI = 0.2
V3 - structural diversity/interspersion (A) SI = 0.1
V4 - % canopy cover (40%) SI = 1.0

CI = $(2V1 \times V2 \times V3)^{1/3} = 0$

TI = $(V1 \times V4)^{1/2} = 0$

HSI = $(CI \times TI)^{1/2} = 0$

TY 30 – V1 - % ground cover (25%) SI = 1.0
V2 - average size of ground cover objects (2 ft) SI = 0.8
V3 - structural diversity/interspersion (C) SI = 1.0
V4 - % canopy cover (75%) SI = 0.33

CI = $(2V1 \times V2 \times V3)^{1/3} = 1.16$ (1.0)

TI = $(V1 \times V4)^{1/2} = 0.57$

HSI = $(CI \times TI)^{1/2} = 0.75$

TY 51 – V1 - % ground cover (50%) SI = 1.0
V2 - average size of ground cover objects (2 ft) SI = 0.8
V3 - structural diversity/interspersion (C) SI = 1.0
V4 - % canopy cover (75%) SI = 0.33

CI = $(2V1 \times V2 \times V3)^{1/3} = 1.16$ (1.0)

TI = $(V1 \times V4)^{1/2} = 0.57$

HSI = $(CI \times TI)^{1/2} = 0.75$

REACH 4 - NORTH END OF BRIDGE TO FOLSOM-AUBURN ROAD (SOUTH ROUTE)

PA 1 - Future Without Project (Impact Area)

OAK WOODLAND

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured)

V1 - % canopy closure of trees and shrubs that produce hard mast (100%)	SI = 1.0
V2 - Density of leaf litter layer (M)	SI = 0.8
V3 - % tree cover (100%)	SI = 1.0
V4 - Den site availability (>4)	SI = 1.0

HSI Food $= (V1 \times V2)^{1/2} = 0.89$ HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = 1.0$

HSI = 0.89 (lowest of values)

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0

HSI = 0.89

TY 51
V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1

HSI = 0.89

PLAIN TITMOUSE

TY 0 - Baseline (measured)

V1 - dbh (6.1-24 in.)	SI = 1.0
V2 - Number trees/acre (>60)	SI = 0.6
V3 - % trees that are oaks (>70%)	SI = 1.0

$$HSI = \frac{V1 + V2 + V3}{3}$$

HSI = 0 .87

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = 0.87

TY 51 V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = 0.87

PA 2 - Future With Project (Impact Area)

Assume: 1. All vegetation removed from temporary and permanent impact zones in year 1
2. temporary easement areas will not be replanted with woody vegetation

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured) HSI = 0.89

TY 1 -
V1 - no trees SI = 0
V2 - low leaf litter SI = 0.2
V3 - no trees SI = 0
V4 - no den sites SI = 0

HSI Food $= (V1 \times V2)^{1/2} = (0 \times 0.2)^{1/2} = 0$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = (0 \times 0)^{1/2} = 0$

HSI = 0

TY 51-
V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1

HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (measured) HSI = 0.87

TY 1 -
V1 - no trees SI = 0.2
V2 - no trees SI = 0
V3 - no trees SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2}{3} = 0.06$$

TY 51 -
V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1

HSI = .06

MP 1 - Management Area - Future Without Project (Compensation Site)

Assume: 1. Annual grassland area selected for conversion to oak woodland.

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated)

V1 - % canopy closure of trees and shrubs that produce hard mast (no trees)	SI = 0
V2 - Density of leaf litter (low)	SI = 0.2
V3 - Den site availability (no trees)	SI = 0

HSI Food $= (V1 \times V2)^{1/2} = (0 \times 0.2)^{1/2} = 0$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = (0 \times 0)^{1/2} = 0$

HSI = 0

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0

HSI = 0

TY 15 - no change from TY 1 HSI = 0

TY 51 - no change from TY 15 HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (estimated)

V1 - dbh (0)	SI = 0.2
V2 - Number trees/acre (0)	SI = 0
V3 - % trees that are oaks (0)	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = .06$$

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = .06

TY 15 - no change from TY 1 HSI = .06

TY 51 - no change from TY 15 HSI = .06

MP 2 - Management Area - Future With Project (Compensation Site)

Assume:
1. Acquire lands (currently annual grasslands)
2. Annual grassland area prepared for planting in TY 1 , provide access and maintenance roads
3. Plant 100% blue and live oak trees (4"x4"x14" tree pots) at a density of 400 trees/acre and cover crop
4. Moderate management intensity (assume 1.5 inches dbh after 10 yrs; 90 percent survival).
5. Watering, weed, pest control for minimum of 3 years and remedial actions as necessary to ensure plant establishment.
6. Assume maximum growth rate of 12"/year
7. Develop O&M manual
8. TY 51 values equal values measured for impact zone

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated) HSI = 0

TY 1 -	V1 - tree species planted /no mast	SI = 0
	V2 - low	SI = 0.2
	V3 - 0 (no trees)	SI = 0
	V4 - 0 (no trees)	SI = 0

HSI = 0

TY 15 -	V1 - oak trees reach 16ft. high 8%	SI = 0.15
	V2 - low	SI = 0.2
	V3 - 8%	SI = 0.15
	V4 - 0	SI = 0

HSI Food $= (V1 \times V2)^{1/2}$
$= (0.15 \times 0.2)^{1/2}$
$= .17$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2}$
$= (0.15 \times 0)^{1/2}$
$= 0$

HSI = 0

TY 51	V1 - 40%	SI = 0.8
	V2 - medium	SI = 0.8
	V3 - 53%	SI = 1.0
	V4 - 24/ac	SI = 1.0

HSI Food $= (V1 \times V2)^{1/2}$
$= (0.8 \times 0.2)^{1/2}$
$= 0.40$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2}$
$= (1.0 \times 1.0)^{1/2}$
$= 1.0$

HSI = 0.40

PLAIN TITMOUSE

TY 0 - Baseline (estimated)

HSI = .06

TY 1 -	V1 - tree species planted (oak) (0 dbh)	SI = 0.2
	V2 - 400 (100% ≤ 16 ft tall; no trees)	SI = 0
	V3 - 100% (no trees)	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = .06$$

TY 15 -	V1 - oak trees reach 16 ft. high (dbh = 1.75)	SI = 0.2
	V2 - ≥ 100 tree/ac	SI = 1.0
	V3 - 100%	SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = .73$$

TY 30 -	V1 - 2.5 dbh	SI = 0.2
	V2 - ≥ 100 tree/ac	SI = 1.0
	V3 - 100%	SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = .73$$

REACH 5 - NEW ACCESS TO BUREAU OF RECLAMATION FACILITIES AND ARWEC RELOCATION

PA 1 - Future Without Project (Impact Area)

OAK WOODLAND

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated)

V1 - % canopy closure of trees and shrubs that produce hard mast (65%) SI = 1.0
V2 - Density of leaf litter layer (L) SI = 0.2
V3 - % tree cover (>50%) SI = 1.0
V4 - Den site availability (>4) SI = 1.0

HSI Food $= (V1 \times V2)^{1/2} = 0.45$ HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = 1.0$

HSI = 0.45 (lowest of values)

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0

HSI = 0.45

TY 51
V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1

HSI = 0.45

PLAIN TITMOUSE

TY 0 - Baseline (measured)

V1 - dbh (0-6 in.) SI = 0.2
V2 - Number trees/acre (10) SI = 0.17
V3 - % trees that are oaks (>70%) SI = 1.0

$$HSI = \frac{V1 + V2 + V3}{3}$$

HSI = 0 .46

TY 1
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = 0.46

TY 51 V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = 0.46

PA 2 - Future With Project (Impact Area)

Assume: 1. All vegetation removed from temporary and permanent impact zones in year 1
2. temporary easement areas will not be replanted with woody vegetation

WESTERN GRAY SQUIRREL

TY 0 - Baseline (measured) HSI = 0.45

TY 1 -		
	V1 - no trees	SI = 0
	V2 - low leaf litter	SI = 0.2
	V3 - no trees	SI = 0
	V4 - no den sites	SI = 0

HSI Food $= (V1 \times V2)^{1/2}$
$= (0 \times 0.2)^{1/2}$
$= 0$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2}$
$= (0 \times 0)^{1/2}$
$= 0$

HSI = 0

TY 51- V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1
V4 - no change from TY 1

HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (measured) HSI = 0.46

TY 1 -		
	V1 - no trees	SI = 0.2
	V2 - no trees	SI = 0
	V3 - no trees	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2}{3} = 0.06$$

TY 51 - V1 - no change from TY 1
V2 - no change from TY 1
V3 - no change from TY 1

HSI = .06

MP 1 - Management Area - Future Without Project (Compensation Site)

Assume: 1. Annual grassland area selected for conversion to oak woodland.

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated)

V1 - % canopy closure of trees and shrubs that produce hard mast (no trees)	SI = 0
V2 - Density of leaf litter (low)	SI = 0.2
V3 - Den site availability (no trees)	SI = 0

HSI Food $= (V1 \times V2)^{1/2} = (0 \times 0.2)^{1/2} = 0$

HSI Cover/Reproduction $= (V3 \times V4)^{1/2} = (0 \times 0)^{1/2} = 0$

HSI = 0

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0
V4 - no change from TY 0

HSI = 0

TY 15 - no change from TY 1 HSI = 0

TY 51 - no change from TY 15 HSI = 0

PLAIN TITMOUSE

TY 0 - Baseline (estimated)

V1 - dbh (0)	SI = 0.2
V2 - Number trees/acre (0)	SI = 0
V3 - % trees that are oaks (0)	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = .06$$

TY 1 -
V1 - no change from TY 0
V2 - no change from TY 0
V3 - no change from TY 0

HSI = .06

TY 15 - no change from TY 1 HSI = .06

TY 51 - no change from TY 15 HSI = .06

MP 2 - Management Area - Future With Project (Compensation Site)

Assume:
1. Acquire lands (currently annual grasslands)
2. Annual grassland area prepared for planting in TY 1 , provide access and maintenance roads
3. Plant 100% blue and live oak trees (4"x4"x14" tree pots) at a density of 400 trees/acre and cover crop
4. Moderate management intensity (assume 1.5 inches dbh after 10 yrs; 90 percent survival).
5. Watering, weed, pest control for minimum of 3 years and remedial actions as necessary to ensure plant establishment.
6. Assume maximum growth rate of 12"/year
7. Develop O&M manual
8. TY 51 values equal values measured for impact zone

WESTERN GRAY SQUIRREL

TY 0 - Baseline (estimated) HSI = 0

TY 1 -

V1 - tree species planted /no mast	SI = 0
V2 - low	SI = 0.2
V3 - 0 (no trees)	SI = 0
V4 - 0 (no trees)	SI = 0

HSI = 0

TY 15 -

V1 - oak trees reach 16ft. high 8%	SI = 0.15
V2 - low	SI = 0.2
V3 - 8%	SI = 0.15
V4 - 0	SI = 0

HSI Food = $(V1 \times V2)^{1/2}$
= $(0.15 \times 0.2)^{1/2}$
= .17

HSI Cover/Reproduction = $(V3 \times V4)^{1/2}$
= $(0.15 \times 0)^{1/2}$
= 0

HSI = 0

TY 51

V1 - 40%	SI = 0.8
V2 - medium	SI = 0.8
V3 - 53%	SI = 1.0
V4 - 24/ac	SI = 1.0

HSI Food = $(V1 \times V2)^{1/2}$
= $(0.8 \times 0.2)^{1/2}$
= 0.40

HSI Cover/Reproduction = $(V3 \times V4)^{1/2}$
= $(1.0 \times 1.0)^{1/2}$
= 1.0

HSI = 0.40

PLAIN TITMOUSE

TY 0 - Baseline (estimated)

HSI = .06

TY 1 -

V1 - tree species planted (oak) (0 dbh)	SI = 0.2
V2 - 400 (100% $\leq$ 16 ft tall; no trees)	SI = 0
V3 - 100% (no trees)	SI = 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{0.2 + 0 + 0}{3} = .06$$

TY 15 -

V1 - oak trees reach 16 ft. high (dbh = 1.75)	SI = 0.2
V2 - $\geq$ 100 tree/ac	SI = 1.0
V3 - 100%	SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = .73$$

TY 51 -

V1 - 2.5 dbh	SI = 0.2
V2 - $\geq$ 100 tree/ac	SI = 1.0
V3 - 100%	SI = 1.0

$$HSI = \frac{0.2 + 1.0 + 1.0}{3} = .73$$

PA 1 - Future Without Project (Impact Area)

RIPARIAN

TY 0 – Baseline (measured)

V1 - % deciduous shrub crown cover (0)	SI = 0
V2 - average height of deciduous shrub canopy (7 ft)	SI = 1.0
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (0)	SI = 0.1

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 1 – no change from baseline

HSI = 0

TY 51 –

V1-10%	SI = 0.17
V2- 7 ft	SI = 1.0
V3- 75%	SI = 0.68

$HSI = (0.17 \times 1.0 \times 0.68)^{1/3} = 0.49$

NORTHERN ORIOLE

TY 0 – Baseline (measured)

V1 - average height of deciduous tree canopy (59 ft)	SI = 1.0
V2 - % deciduous tree crown cover (100%)	SI = 0.8
V3 – stand width (<300 ft)	SI = 0.5

HSI = $(V1 \times V2 \times V3)^{1/3}$ = 0.93

TY 1 – no change from baseline

HSI = 0.93

TY 51 – no change from baseline

HSI = 0.93

WESTERN FENCE LIZARD

TY 0 – Baseline (measured)

V1 - % ground cover (100%) SI =	SI = 0
V2 - average size of ground cover objects (2 ft)	SI = 0.8
V3 - structural diversity/interspersion (C)	SI = 1.0
V4 - % canopy cover (100 %)	SI = 0.3

CI = $(2V1 \times V2 \times V3)^{1/3}$ = 0
TI = $(V1 \times V4)^{1/2}$ = 0

HSI = $(CI \times TI)^{1/2}$ = 0

TY 1 – no change from baseline

HSI = 0

TY 51 – no change from baseline

HSI = 0

PA 2 - Future With Project (Impact Area)

Assume: 1. All vegetation removed from temporary and permanent impactzones in year 1.
2. Temporary easement areas will not be replanted with woody vegetation.

YELLOW WARBLER

TY 0 – Baseline (measured)

V1 - % deciduous shrub crown cover
V2 - average height of deciduous shrub canopy
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 1	– V1 – no shrubs	SI = 0
	V2 – no shrubs	SI = 0
	V3 - no shrubs	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 51	– V1 – no shrubs	SI = 0
	V2 – no shrubs	SI = 0
	V3 - no shrubs	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

NORTHERN ORIOLE

TY 0 – Baseline (measured)

V1 - average height of deciduous tree canopy
V2 - % deciduous tree crown cover
V3 – stand width

$HSI = (V1 \times V2 \times V3)^{1/3}$

TY 1 -	V1 – no trees	SI = 0
	V2 – no trees	SI = 0
	V3 – no trees	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 51	– V1 – no trees	SI = 0
	V2 – no trees	SI = 0
	V3 – no trees	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

WESTERN FENCE LIZARD

TY 0 – Baseline (measured)

V1 - % ground cover
V2 - average size of ground cover objects
V3 - structural diversity/interspersion
V4 - % canopy cover

$CI = (2V1 \times V2 \times V3)^{1/3}$

$TI = (V1 \times V4)^{1/2}$

$HSI = (CI \times TI)^{1/2} = 0.63$ (average of transects)

TY 1 –	V1 – no ground cover	SI = 0
	V2 – no cover objects	SI = 0
	V3 – A	SI = 0.1
	V4 – no canopy cover	SI = 1.0

$CI = (2V1 \times V2 \times V3)^{1/3} = 0$

$TI = (V1 \times V4)^{1/2} = 0$

$HSI = (CI \times TI)^{1/2} = 0$

TY 51 – No change from TY 1

MP 1 – Management Area – Future Without the Project (Compensation Site)

Assume: 1. Existing riparian river bank upstream of Rossmoor Bar can be enhanced by planting riparian species (south side of river).

YELLOW WARBLER

TY 0 – Baseline (measured)

V1 - % deciduous shrub crown cover (0)	SI = 0
V2 - average height of deciduous shrub canopy (5 ft)	SI = 0.82
V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (0)	SI = 0

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 1 – no change from baseline
HSI = 0

TY 15 – no change from baseline
HSI = 0

TY 30 – no change from baseline
HSI = 0

TY 51 – no change from baseline
HSI = 0

NORTHERN ORIOLE

TY 0 – Baseline (measured)

V1 - average height of deciduous tree canopy (27 ft)	SI = 0.77
V2 - % deciduous tree crown cover (0)	SI = 0
V3 – stand width (1)	SI = 0.2

$HSI = (V1 \times V2 \times V3)^{1/3} = 0$

TY 1 – no change from baseline
HSI = 0

TY 15 – no change from baseline
HSI = 0

TY 30 – no change from baseline
HSI = 0

TY 51 – no change from baseline
HSI = 0

WESTERN FENCE LIZARD

TY 0 – Baseline (measured)

V1 - % ground cover (0)	SI = 0
V2 - average size of ground cover objects (< 1 ft)	SI = 0.2
V3 - structural diversity/interspersion (A)	SI = 0.1
V4 - % canopy cover (0)	SI = 1.0

$CI = (2V1 \times V2 \times V3)^{1/3} = 0$

$TI = (V1 \times V4)^{1/2} = 0$

$HSI = (CI \times TI)^{1/2} = 0$

TY 1 – no change from baseline
HSI = 0

TY 15 – no change from baseline
HSI = 0

TY 30 – no change from baseline
HSI = 0

TY 51 – no change from baseline
HSI = 0

MP 2 – Management Area – Future With Project (Compensation Site)

Assume:
1. Acquire lands.
2. Watering, weed and pest management for a minimum of 3 years and remedial actions as necessary to ensure plant establishment.
3. Willow species and cottonwoods (80% of woody plantings willbe planted near the mean summer water surface elevation and less water tolerant plants (oaks, etc) will be planted higher on the bank.
4. The site will extend no more than 25 feet up the bank from mean summer water surface elevation.
5. Assume average growth rate of 24 inches/year for willows and cottonwood trees.

YELLOW WARBLER

TY 0 – Baseline (measured)

	V1 - % deciduous shrub crown cover (0)	SI = 0
	V2 - average height of deciduous shrub canopy (5 ft)	SI = 0.82
	V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (0)	SI = 0

HSI = (V1 x V2 x V3)$^{1/3}$ = 0

TY 1	– V1 - % deciduous shrub crown cover (5%)	SI = 0.15
	V2 - average height of deciduous shrub canopy (1 ft)	SI = 0.17
	V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (80%)	SI = 0.80

HSI = (0.15 x 0.17 x 0.80)$^{1/3}$ = 0.14

TY 15	– V1 - % deciduous shrub crown cover (75%)	SI = 1.0
	V2 - average height of deciduous shrub canopy (5ft)	SI = 0.82
	V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (80%)	SI = 0.80

HSI = (1.0 x 0.82 x 0.80)$^{1/3}$ = 0.81

TY 30	– V1 - % deciduous shrub crown cover (75%)	SI = 1.0
	V2 - average height of deciduous shrub canopy (5ft)	SI = 0.82
	V3 - % deciduous shrub canopy comprised of hydrophytic shrubs (80%)	SI = 0.80

HSI = (1.0 x 0.82 x 0.80)$^{1/3}$ = 0.81

TY 51 – no change from TY 30

NORTHERN ORIOLE

TY 0 – Baseline (measured)

V1 - average height of deciduous tree canopy (27 ft)	SI = 0.77
V2 - % deciduous tree crown cover (0)	SI = 0
V3 – stand width (1)	SI = 0.2

HSI = $(V1 \times V2 \times V3)^{1/3} = 0$

TY 1 –	V1 - average height of deciduous tree canopy (27 ft)	SI = 0.77
	V2 - % deciduous tree crown cover (0)	SI = 0
	V3 – stand width (< 300 ft)	SI = 0.5

HSI = $(V1 \times V2 \times V3)^{1/3} = 0$

TY 15 –	V1 - average height of deciduous tree canopy (16 ft)	SI = 0.77
	V2 - % deciduous tree crown cover (25%)	SI = 1.0
	V3 – stand width (< 300 ft)	SI = 0.5

HSI = $(0.77 \times 1.0 \times 0.5)^{1/3} = 0.54$

TY 30 –	V1 - average height of deciduous tree canopy (40 ft)	SI = 1.0
	V2 - % deciduous tree crown cover (50%)	SI = 1.0
	V3 – stand width (< 300 ft)	SI = 0.5

HSI = $(1.0 \times 1.0 \times 0.5)^{1/3} = 0.79$

TY 51 -	V1 - average height of deciduous tree canopy (80 ft)	SI = 1.0
	V2 - % deciduous tree crown cover (75%)	SI = 0.9
	V3 – stand width (< 300 ft)	SI = 0.5

HSI = $(1.0 \times 0.9 \times 0.5)^{1/3} = 0.77$

WESTERN FENCE LIZARD

TY 0 – Baseline (measured)

V1 - % ground cover (0)	SI = 0
V2 - average size of ground cover objects (< 1 ft)	SI = 0.2
V3 - structural diversity/interspersion (A)	SI = 0.1
V4 - % canopy cover (0)	SI = 1.0

$CI = (2V1 \times V2 \times V3)^{1/3} = 0$

$TI = (V1 \times V4)^{1/2} = 0$

$HSI = (CI \times TI)^{1/2} = 0$

TY 1 –

V1 - % ground cover (0)	SI = 0
V2 - average size of ground cover objects (< 1 ft)	SI = 0.2
V3 - structural diversity/interspersion (A)	SI = 0.1
V4 - % canopy cover (0)	SI = 1.0

$CI = (2V1 \times V2 \times V3)^{1/3} = 0$

$TI = (V1 \times V4)^{1/2} = 0$

$HSI = (CI \times TI)^{1/2} = 0$

TY 15 –

V1 - % ground cover (5%)	SI = 0
V2 - average size of ground cover objects (≤ 1 ft)	SI = 0.2
V3 - structural diversity/interspersion (A)	SI = 0.1
V4 - % canopy cover (40%)	SI = 1.0

$CI = (2V1 \times V2 \times V3)^{1/3} = 0$

$TI = (V1 \times V4)^{1/2} = 0$

$HSI = (CI \times TI)^{1/2} = 0$

TY 30 –

V1 - % ground cover (25%)	SI = 1.0
V2 - average size of ground cover objects (2 ft)	SI = 0.8
V3 - structural diversity/interspersion (C)	SI = 1.0
V4 - % canopy cover (75%)	SI = 0.33

$CI = (2V1 \times V2 \times V3)^{1/3} = 1.16$ (1.0)

$TI = (V1 \times V4)^{1/2} = 0.57$

$HSI = (CI \times TI)^{1/2} = 0.75$

TY 51 –

V1 - % ground cover (50%)	SI = 1.0
V2 - average size of ground cover objects (2 ft)	SI = 0.8
V3 - structural diversity/interspersion (C)	SI = 1.0
V4 - % canopy cover (75%)	SI = 0.33

$CI = (2V1 \times V2 \times V3)^{1/3} = 1.16\ (1.0)$

$TI = (V1 \times V4)^{1/2} = 0.57$

$HSI = (CI \times TI)^{1/2} = 0.75$

PA 1 - Future Without Project (Impact Area)

SEASONAL WETLAND

GREAT EGRET

TY 0 – Baseline (measured)

V1 - % area with water 4-9 inches deep
V2 - % of substrate in zone 4-9 inches deep with sub- and emergent vegetation

$$HSI = \frac{V1 + V2}{2} = 0.23$$

TY 1 – no change from baseline

HSI = 0.23

TY 51 – no change from baseline

HSI = 0.23

RED-WINGED BLACKBIRD

TY 0 – Baseline (measured)

V6 quality of foraging areas within 620 feet of suitable nest areas

Condition C wetland $HSI = (0.1 \times V6)^{1/2} = 0.2$

TY 1 – no change from baseline

HSI = 0.2

TY 51 – no change from baseline

HSI = 0.2

CALIFORNIA VOLE

TY 0 – Baseline (measured)

V1 – Height herbaceous vegetation
V2 - % herbaceous cover
V3 – Soil type

$$HSI = \frac{V1 + V2 + V3}{3} = 0.76$$

TY 1 – no change from baseline

HSI = 0.76

TY 51 – no change from baseline

HSI = 0.76

PA 2 - Future With Project (Impact Area)

Assume:
1. All vegetation removed from temporary and permanent impact zones in year 1
2. temporary easement areas will not be replanted with woody vegetation
3. existing drainages culverted under roads

GREAT EGRET

TY 0 – Baseline (measured)

V1 - % area with water 4-9 inches deep
V2 - % of substrate in zone 4-9 inches deep with sub- and emergent vegetation

$$HSI = \frac{V1 + V2}{2} = 0.23$$

TY 1 – V1 – 0 SI = 0
V2 - 0 SI = 0.1

$$HSI = \frac{0 + 0.1}{2} = 0.05$$

TY 51 – no change from TY 1

HSI = 0.05

RED-WINGED BLACKBIRD

TY 0 – Baseline (measured)

V6 quality of foraging areas within 620 feet of suitable nest areas

Condition C wetland HSI = $(0.1 \times V6)^{1/2} = 0.2$

TY 1 – no change from baseline

HSI = 0

TY 51 – no change from baseline TY 1

HSI = 0

CALIFORNIA VOLE

TY 0 – Baseline (measured)

V1 – Height herbaceous vegetation
V2 - % herbaceous cover
V3 – Soil type

$$HSI = \frac{V1 + V2 + V3}{3} = 0.76$$

TY 1 –	V1 – 0	SI = 0
	V2 – 0	SI = 0
	V3 – not silty or loamy ; not friable	SI = 0.2

$$HSI = \frac{0 + 0 + 0.2}{3} = 0.06$$

TY 51 – no change from TY 1

HSI = 0.06

MP 1 - Future Without Project (Compensation Area)

Assumption: 1. Annual grassland area will be converted to wetlands

GREAT EGRET

TY 0 - Baseline (measured)

V1 - % of area with water 4-9 inches deep (0) SI = 0

V2 - % of area 4-9 deep with emergent/submergent vegetation (0) SI = .1

$$HSI = \frac{V1 + V2}{2} = \frac{0 + 0.1}{2} = .05$$

TY 1 no change from TY 0

TY 4 no change from TY 1

TY 51 no change from TY 4

CALIFORNIA VOLE

TY 0 - Baseline (estimated)

V1 - Height of herbaceous vegetation (≥ 6in.) SI = 1.0

V2 - % cover of herbaceous vegetation (80%) SI = 6.7

V3 - soil type (mod. friable) SI = 0.5

TY 1 - V1 - no change from TY 0

V2 - no change from TY 0

V3 - no change from TY 0

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{1.0 + 0.7 + 0.5}{3} = .73$$

TY 4 - V1 - no change from TY 1

TY 51 - V1 - no change from TY 4

RED-WINGED BLACKBIRD

TY 0 - Baseline (estimated) - upland area unsuitable for species HSI = 0

TY 1 - no change from TY 0

TY 4 - no change from TY 1

TY 51 - no change from TY 4

MP 2 - Future With Project (Compensation Site)

Assumption:

1. Acquire annual grassland area
2. Portion of wetland area will have permanent water
3. Wetland will be designed to provide equal mix of open water and emergent vegetation
4. Carp will not be stocked
5. Site baseline is a Condition C wetland.
6. Site is minimum of 1-acre in size and access and maintenance roads are provided.
7. 40% of area designed for summer conditions of water 4-9 in deep
8. Plant appropriate wetland plant species, provide pest control and maintenance as needed for minimum of 3 years or until wetland is established.
9. Cover crop planted on all disturbed non-wetland areas.

GREAT EGRET

TY 0 - Baseline (estimated)

V1 - % of area with water 4-9 inches deep (0)	SI = 0
V2 - % of area with water 4-9 deep with emergent/submergent vegetation	SI = 0.1

$$HSI = \frac{V1 + V2}{2} = \frac{0 + 0.1}{2} = .05$$

TY 1 -

V1 - 40%	SI = 0.4
V2 - 5%	SI = 0.2

$$HSI = \frac{0.4 + 0.2}{2} = \frac{0.6}{2} = .30$$

TY 4 -

V1 - 40%	SI = 0.4
V2 - 40% - 60%	SI = 1.0

$$HSI = \frac{0.4 + 1.0}{2} = .70$$

TY 51 - no change from TY 4

HSI = .70

CALIFORNIA VOLE

TY 0 - Baseline (estimated)

V1 - Height of herbaceous vegetation ($\geq$ 6 in.)	SI = 1.0
V2 - % cover of herbaceous vegetation (80%)	SI = 0.7
V3 - soil type (mod friable)	SI = 0.5

$$HSI = \frac{V1 + V2 + V3}{3} = \frac{1.0 + 0.7 + 0.5}{3} = .73$$

TY 1 - V1 - $\geq$ 6 in — SI = 1.0
V2 - 90% — SI = 0.85
V3 - no change fro baseline — SI = 0.5

$$HSI = \frac{1.0 + 0.85 + 0.5}{3} = .78$$

TY 4 - V1 - no change from TY 1 — SI = 1.0
V2 - 100% — SI = 0
V3 - no change from TY 1 — SI = 0.5

$$HSI = \frac{1.0 + 0.85 + 0.5}{3} = .78$$

TY 51- V1 - no change from TY 4
V2 - no change from TY 4
V3 - no change from TY 4

HSI = .78

RED-WINGED BLACKBIRD

TY 0 - Baseline (estimated) - upland area unsuitable for specie

HSI = 0

TY 1 - V1 - Emergent vegetation is old/new growth monocot (other) — SI = 0.1
V2 - Water present throughout year (yes) — SI = 1.0
V3 - Carp presence (absent) — SI = 1.0
V4 - larvae of dragonflies/damselflies presence (yes) — SI = 1.0
V5 - vegetation density (sparse first year) — SI = 0.1

$$HSI = (V1 + V2 + V3 + V4 + V5)^{1/2} = (0.1 \times 1.0 \times 1.0 \times 1.0 \times 0.1)^{1/2} = 0.1$$

TY 4 - V1 - old/new growth monocots — SI = 1.0
V2 - no change — SI = 1.0
V3 - no change — SI = 1.0
V4 - no change — SI = 1.0
V5 - 50% — SI = 1.0

$$HSI = (1.0 \times 1.0 \times 1.0 \times 1.0 \times 1.0)^{1/2} = 1.0$$

TY 51 - no change from TY 4

HSI = 1.0

APPENDIX A-2

HSI MODELS

NORTHERN ORIOLE
HABITAT SUITABILITY INDEX MODEL

HABITAT SUITABILITY INDEX MODEL

NORTHERN ORIOLE (*Icterus spurius*)

BREEDING HABITAT, CENTRAL VALLEY

CALIFORNIA

U.S. Fish and Wildlife Service
Ecological Services
Sacramento, California

January 1988

COVER TYPE	LIFE REQUISITE	HABITAT VARIABLES
		Average height of deciduous tree canopy (V_1)
Valley Woodland (W) Riparian (R)	Reproduction/Cover	Percent deciduous tree Crown cover (V_2)
		Stand width (V_3)

FOOD

The diet of the northern oriole is comprised mainly of insects. Fruits, berries, and nectar are also utilized (Bent 1958; Martin et al. 1961). For purposes of this model, it is assumed that if suitable habitat is available for nesting and cover, food resources are not limiting.

Minimum habitat area

Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before an area will be occupied by a species. Based on reported pair densities (Walcheck 1970; Gaines 1974; Pleasant 1979), it is assumed that at least 0.25 acres of suitable habitat must be available for the northern oriole to occupy an area. If less than this amount is present, the HSI is assumed to be zero.

VARIABLE	HABITAT TYPE	SUGGESTED TECHNIQUE
V_1 Average height of deciduous tree canopy	R, W	Range finder and clinometer on belt transect
V_2 Percent deciduous tree crown cover	R, W	Line intercept
V_3 Stand width	R, W	Visual observation, aerial interpretation

HSI Determination

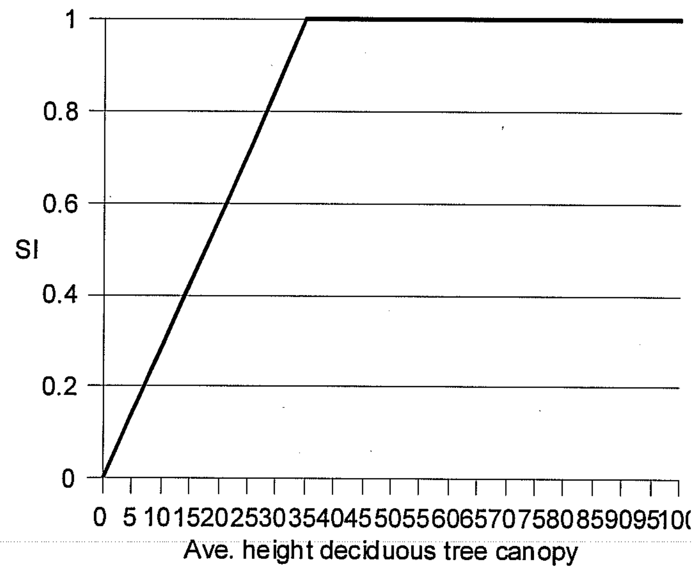
LIFE REQUISITE	COVER TYPE	EQUATION
Reproduction	R, W	$(V_1 \times V_2 \times V_3)^{1/3}$

The HSI value for the northern oriole is equal to the reproduction/cover value.

Model Applicability
The model applies to breeding habitat of the northern oriole in the Central Valley of California up to 500 feet in elevation.

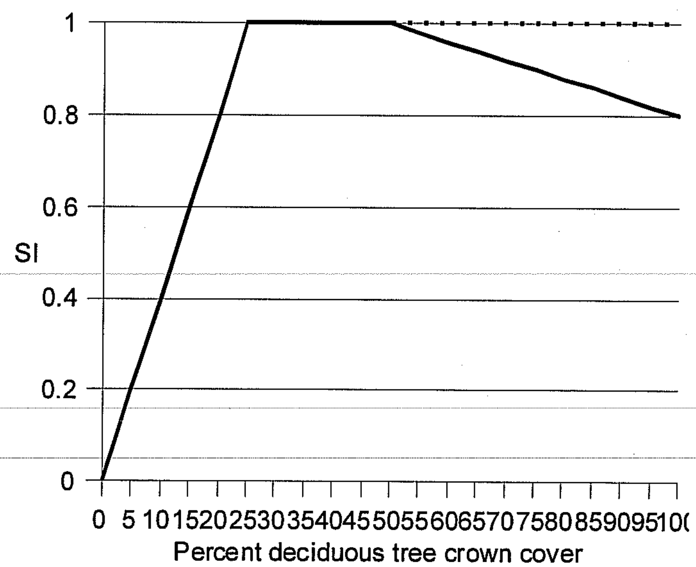
1. Average height of deciduous tree canopy.

Assumption: Orioles nest almost exclusively in large, preferably deciduous, trees (derived from nesting data of Schaefer (1976A)). Tree height of 35 feet or greater is optimum the dominant canopy strata equals those trees comprising 50% of total canopy closure.



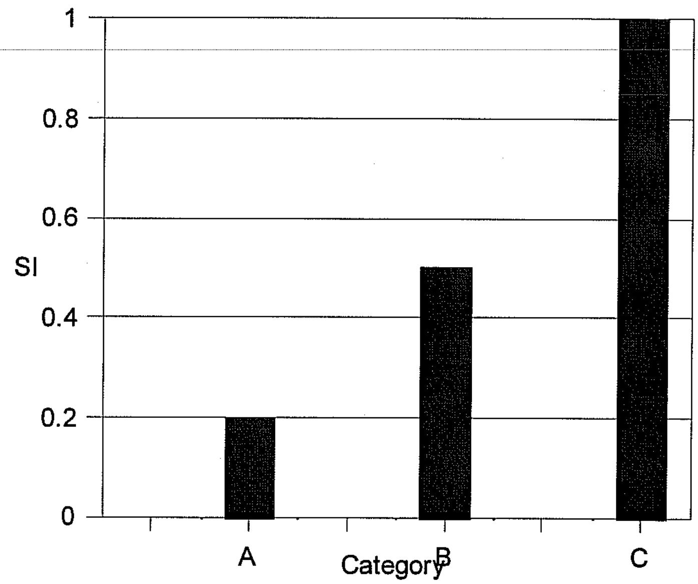
2. Percent deciduous tree crown cover.

Assumption: Orioles prefer open stands of deciduous trees for nesting (Grinnel and Miller 1944). Crown cover of 25-50% is assumed to be optimum.



3. Stand width

Assumption: Orioles prefer large blocks of riparian or oak woodland for nesting (USFWS 1981).



A - Woodland a narrow band comprising the width of one tree.
B - Woodland a strip less than 300 feet wide at its widest point.
C - Woodland greater than 300 feet wide at widest point.

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WESTERN FENCE LIZARD
HABITAT SUITABILITY INDEX MODEL

HABITAT SUITABILITY INDEX MODEL

WESTERN FENCE LIZARD (*Sceloporus occidentalis*)

by
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Sacramento, California

March 1989

INTRODUCTION

The western fence lizard (*Sceloporus occidentalis*) ranges from British Columbia southward through Washington, Oregon and throughout California and the Great Basin to northwestern Baja California (Smith, 1948; Stebbins, 1985). It occupies a wide variety of habitats, excluding extreme desert conditions, from sea level to over 9500 feet in the Sierra Nevada. In California, four subspecies are present (Jennings, 1987). Preferring wooded, rocky areas, it frequents talus and rocky outcrops of hillsides, canyons and along streams. Western fence lizards are attracted to old buildings, woodpiles, fences, telephone poles, woodrat nests and banks with rodent burrows. It requires cover and, except for dispersing females (Jennings, personal communication) is seldom encountered in open fields or extremely barren areas (Stebbins, 1954). It is frequently a colonizer of disturbed habitats (Lillywhite, et.al., 1977).

The western fence lizard can be semi-arboreal (Cunningham, 1955; Davis and Verbeek, 1972). Trees apparently do not constitute a life requisite as was shown by *Sceloporus occidentalis* populations in chaparral (Lillywhite, Friedman and Ford 1972) and at high elevations (Grinnell and Storer, 1924). Trees may simply act as another type of available cover. This indicates the microhabitat plasticity of this species (Rose, 1978).

MODEL APPLICABILITY

This model was designed for use in plant communities found in the Central Valley of California and surrounding foothills up to an elevation of approximately 1500 feet and applies to the subspecies *S. o. occidentalis* and *S.o. biseriatus*. The model is based on both empirical data provided by expert review and information obtained from current literature.

Cover Type	Life Requisite	Habitat Variable
		Percent ground cover (V_1)
	Cover/Reproduction	Average size of ground cover objects (V_2)
Riparian (R) Oak savannah (O) Oak woodland (W) Scrub (S) Annual Grassland (G)		Structural diversity/ Interspersion (V_3)
		Percent ground cover (V_1)
	Thermoregulation	
		Percent canopy cover (V_4)

Habitat Variable	Cover Type	Suggested Techniques
V_1 - Percent ground cover	R.O.W.S,G	Line intercept, measurement of random points using a 3 feet diameter loop.
V_2 - Average size of ground cover objects	R.O.W.S,G	Line intercept
V_3 - Structural diversity/ interspersion	R.O.W.S,G	Ocular estimate
V_4 - Percent canopy cover	R.O.W.S,G	Spherical densiometer, line intercept, point intercept on aerial photos.

Variable 1. Percent ground cover

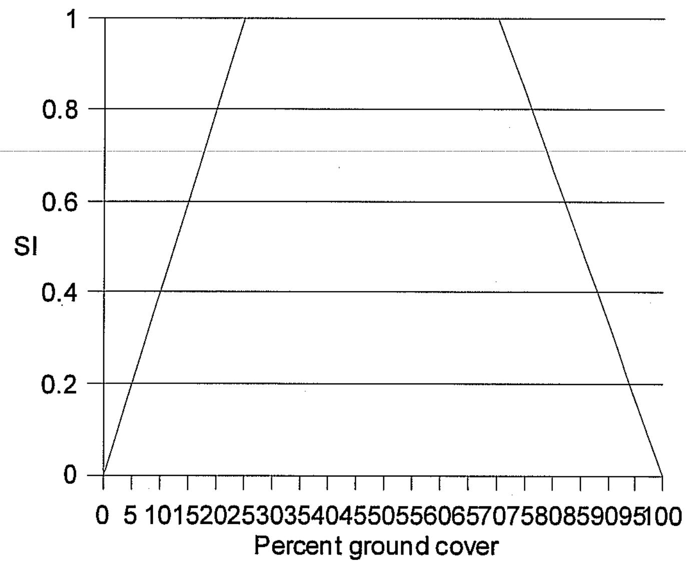
Assumes:

Only those objects less than 8 feet above the ground surface are considered. This includes rocks, logs, branches, tree trunks, fences, wood piles and live vegetation. Western fence lizards exhibit no well-defined habitat preference, but favor areas with logs, trees or other objects upon which they can climb, sun and display (Fitch, 1940). Brush piles and cavities under rocks and logs provide refuge (Marcellini and Mackey, 1979). An amount of ground cover beyond a particular density results in less than optimal conditions as it conceals predators and interferes with movement and the ability to defend a territory (Davis and Ford, 1983). Davis and Verbeek (1972) found that western fence lizards avoided dense grasslands. However, dispersing juveniles will cross dense grasslands and colonize any suitable isolated habitat found (Jennings, personal communication).

In California, western fence lizards centered their territorial activities about logs, fence posts, stumps and exposed boulders from which males display (Carpenter, 1980) and to observe mates or rival males (Fitch, 1940).

Eggs are placed in damp, friable, well-aerated soil from mid-May to mid-July in pits dug by the female and covered with loose soil (Stebbins, 1954) or under rocks and logs (Jennings, personal communication). In non-riparian conditions, nest sites are probably limited to areas within the shade of large cover objects.

Ground cover ranging from 25 to 70 percent is considered optimum for western fence lizards as it provides sufficient cover for maximum use of an area while not being so abundant as to interfere with movement. Western fence lizards undergo hibernation from November to February (Smith, 1946) and require cover for winter survival (Jennings, personal communication).



Variable 2. Average size of ground cover objects.

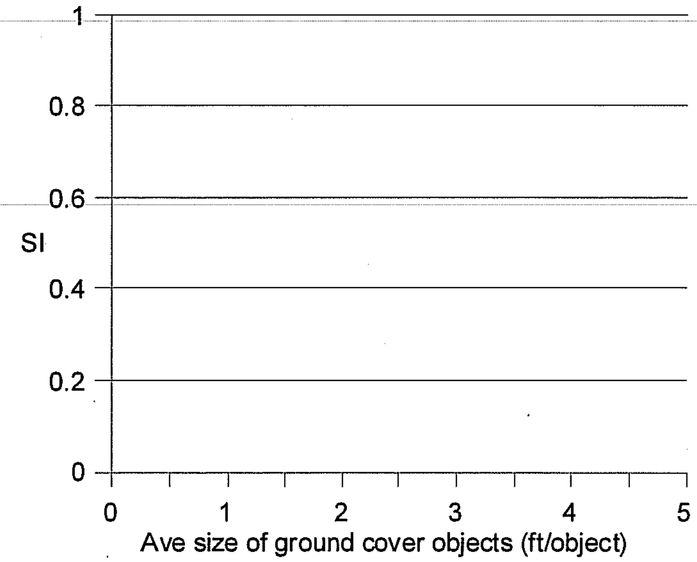
Assumes:

Ground cover objects include tree trunks but no other living material. The objects must be sufficiently large to provide escape cover. Western fence lizards have the habit of running to the opposite side of their perch (rock, log, etc.) when approached (Nussbaum et al., 1983). The objects must also be large enough to provide cover for hibernation, nest building, shade for summer thermoregulation, and to offer vantage points for territorial defense and mating display.

An average ground cover object size of 3.0 feet and larger is considered optimum as it is sufficiently large to provide for escape cover, thermoregulation and reproductive needs.

The average size of ground cover objects greater than 4 inches is diameter are measured in the field using the line intercept method and is determined by the formula:

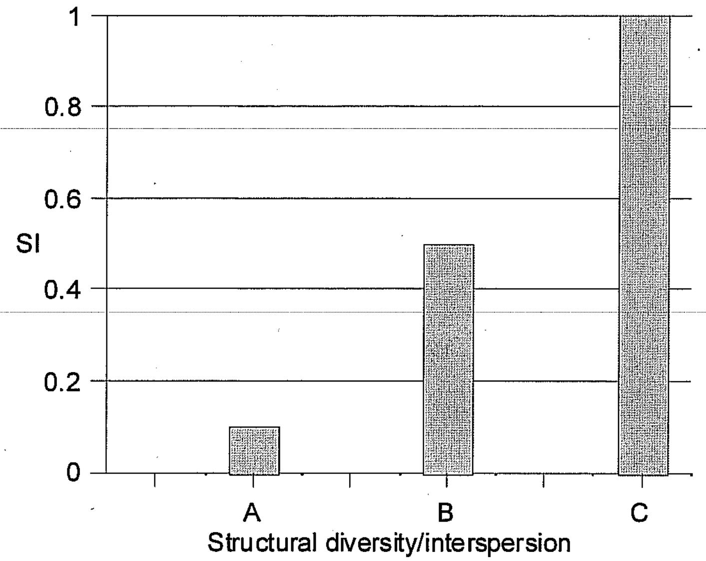
$$\text{Average size of ground cover objects} = \frac{\text{Total feet of line intercepted}}{\text{Total number of ground cover objects intercepted}}$$



Variable 3. Structural diversity/interspersion

Assumes:

This variable is related to the habitat heterogeneity. The western fence lizard areas have a mixture and sufficient quantity of cover types (rocks, logs, living vegetation, rodent burrows, cracks and crevices) in a semi-open environment with lots of habitat edge allowing for sufficient exposure to the sun (Ruth, personal communication), escape cover and a production base for food organisms (Jennings, personal communication). These areas usually have a significant vertical component in the form of large boulders, trees, fence rows, old buildings or log piles (Nussbaum et al, 1983). Davis and Ford (1983) found optimal habitat was provided by large fallen oaks in various stages of decay or by large, standing oaks from which limbs and branches had fallen to the ground creating massive tangles. Western fence lizards commonly show low distributions in climax communities due to the homogeneity of the habitat(Ruth, personal communication).



A - Low habitat diversity. Ground cover limited to 1 or 2 types (i.e., grassland and bare soil). Site mostly homogeneous with little edge. Cover component mostly one dimensional without a significant vertical element (average less than 1 foot above ground). An exception may be rock talus which can be good (Ruth, communication).

B - Moderate habitat diversity. Two or more major ground cover types occur (i.e., large rocks, logs and woodpiles). A moderate amount of edge and interspersion is present between vegetation types and/or ground cover types. A significant vertical element to the cover component (average 1 -4 feet above ground) is present.

C - High habitat diversity. Three or more major ground cover types are present (i.e., large rocks, logs and woodpiles). Heterogeneity is high with logs of edge between evenly dispersed vegetation and cover types. Overall, habitat has a significant vertical component (average greater than 4 feet above ground). May include rock talus.

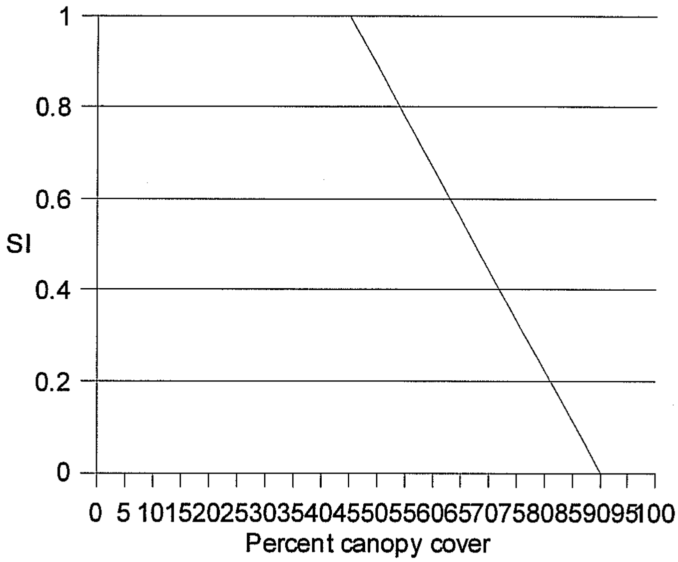
Variable 4. Percent canopy cover

Assumes:

The canopy is defined as standing live vegetation greater than 6 feet above ground. This variable relates directly to the ability of the habitat to provide sufficient exposure so that western fence lizards can thermoregulate.

The ability of a western fence lizard to thermoregulate in an area is a major determinant of its habitat occupancy. The ability of this species to absorb sunlight and warm quickly enables it to inhabit areas from sea level to over 9000 feet in elevation (Tanner and Hopkin, 1972). Western fence lizards typically move from areas of sunlight to shade to maintain their desired body temperature. Davis and Verbeek (1972) found this species shifted from rocks to trees and vice versa according to ambient temperature. Western fence lizards avoid dense, shaded woods (Stebbins, 1959).

A canopy cover ranging from 0 - 45 percent is considered optimum as it provides sufficient sunlight on the ground or ground cover surface for thermoregulation by western fence lizards. An area with a canopy cover greater than 90 percent is considered uninhabitable for western fence lizards due to a lack of sunlight on the ground surface for thermoregulation.



CALCULATIONS

Life Requisite	Cover Type	Index and Equation
Cover//Reproduction	R.O.W.S,G	$CI = (2V_1 \times V_2 \times V_3)^{1/3}$
Thermoregulation	R.O.W.S,G	$TI = (V_1 \times V_4)^{½}$

HSI Determination $HSI = (CI \times TI)^{½}$

Assumes percent ground cover is the major determining factor due to its importance in reproduction, predator avoidance and thermoregulation.

An HSI value of 1.0 is considered optimum. An HSI value greater than 1.0 achieved through the use of this formula is to be considered 1.0.

Feeding

It is assumed that where all necessary habitat components are present, food availability is not a factor limiting the use of an area by western fence lizards. Low availability of insects may be a limiting factor on winter recruitment of juveniles into the adult population (Jennings, personal communication). In arid areas, food can be limiting to adults in late summer (Ruth, personal communication).

The western fence lizard is an opportunistic insectivore which feeds on a variety of insects and other arthropods including leaf hoppers, aphids, beetles, wasps, termites, ants and spiders (Fitch, 1940; Johnson, 1965; Rose, 1976; Stebbins, 1954).

Rose (1976) found the three primary groups in the fence lizard diet to be ants (*Formicidae*), beetles (*Coleoptera*) and termites (*Isoptera*). Johnson (1965) found flies (*Diptera*), beetles and ants to be important prey while Clark (1973) found grasshoppers (*Acrididae*) the most common prey item. Otvos (1977) found moths or butterflies (*Lepidoptera*) the most common prey item in stomachs analyzed. Western fence lizards commonly bask or loaf in the shade and eat whatever arthropod comes close enough to attract their attention (Tanner and Hopkin, 1972). It can therefore be assumed that food availability is not a limiting factor under normal lizard population levels and habitat conditions.

Reproduction

It is assumed that, if ground cover of rocks, logs, trees, woodpiles, etc. of sufficient size and quantity are available for non-reproductive activities, then areas with moist, friable soil necessary for lizard nesting purposes would be present beneath the cover and should not be a limiting factor. Females may travel several hundred feed to find appropriate nesting conditions (Ruth, personal communication).

Water requirements

Considering the wide distribution of this species in all but the most extreme desert regions, it is unlikely that water availability would be a limiting factor to the western fence lizard though densities are often highest where water (seeps, ponds, etc.)are nearby (Ruth, personal communication). This assumes that sufficient ground cover exists for thermoregulation and nesting. This species receives the bulk of its moisture through metabolic water from its prey (Ruth, personal communication). These lizards may lower metabolic rates to compensate for higher body temperatures and water stress during warm seasons (Tsuji, 1985).

ACKNOWLEDGMENTS

We thank Mark R. Jennings, PhD., Department of Herpetology, California Academy of Sciences, Dixon, California and Stephen B. Ruth, Ph.D., Monterey Peninsula College, Monterey, California for reviewing the draft model and for providing field observations, data and suggestions which aided in establishing field applicability for the model. Their contributions are greatly appreciated.

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FWS/OBS-82/10.27
July 1982

HABITAT SUITABILITY INDEX MODELS: YELLOW WARBLER

by

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PREFACE

This document is part of the Habitat Suitability Index (HSI) Model Series (FWS/OBS-82/10), which provides habitat information useful for impact assessment and habitat management. Several types of habitat information are provided. The Habitat Use Information Section is largely constrained to those data that can be used to derive quantitative relationships between key environmental variables and habitat suitability. The habitat use information provides the foundation for HSI models that follow. In addition, this same information may be useful in the development of other models more appropriate to specific assessment or evaluation needs.

The HSI Model Section documents a habitat model and information pertinent to its application. The model synthesizes the habitat use information into a framework appropriate for field application and is scaled to produce an index value between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). The application information includes descriptions of the geographic ranges and seasonal application of the model, its current verification status, and a listing of model variables with recommended measurement techniques for each variable.

In essence, the model presented herein is a hypothesis of species-habitat relationships and not a statement of proven cause and effect relationships. Results of model performance tests, when available, are referenced. However, models that have demonstrated reliability in specific situations may prove unreliable in others. For this reason, feedback is encouraged from users of this model concerning improvements and other suggestions that may increase the utility and effectiveness of this habitat-based approach to fish and wildlife planning. Please send suggestions to:

Habitat Evaluation Procedures Group
Western Energy and Land Use Team
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Ft. Collins, CO 80526

ACKNOWLEDGMENTS

We gratefully acknowledge Douglas H. Morse for his review of this habitat model. The cover of this document was illustrated by Jennifer Shoemaker. Word processing was provided by Carolyn Gulzow and Dora Ibarra.

YELLOW WARBLER (*Dendroica petechia*)

HABITAT USE INFORMATION

General

The yellow warbler (*Dendroica petechia*) is a breeding bird throughout the entire United States, with the exception of parts of the Southeast (Robbins et al. 1966). Preferred habitats are wet areas with abundant shrubs or small trees (Bent 1953). Yellow warblers inhabit hedgerows, thickets, marshes, swamp edges (Starling 1978), aspen (*Populus* spp.) groves, and willow (*Salix* spp.) swamps (Salt 1957), as well as residential areas (Morse 1966).

Food

More than 90% of the food of yellow warblers is insects (Bent 1953), taken in proportion to their availability (Busby and Sealy 1979). Foraging in Maine occurred primarily on small limbs in deciduous foliage (Morse 1973).

Water

Dietary water requirements were not mentioned in the literature. Yellow warblers prefer wet habitats (Bent 1953; Morse 1966; Stauffer and Best 1980).

Cover

Cover needs of the yellow warbler are assumed to be the same as reproduction habitat needs are discussed in the following section.

Reproduction

Preferred foraging and nesting habitats in the Northeast are wet areas, partially covered by willows and alders (*Alnus* spp.), ranging in height from 1.5 to 4 m (5 to 13.3 ft) (Morse 1966). It is unusual to find yellow warblers in extensive forests (Hebard 1961) with closed canopies (Morse 1966). Yellow warblers in small islands ofmixed coniferous-deciduous growth in Maine utilized deciduous foliage far more frequently than would be expected by chance alone (Morse 1973). Coniferous areas were mostly avoided and areas of low deciduous growth preferred.

Nests are generally placed 0.9 to 2.4 m (3 to 8 ft) above the ground, and nest heights rarely exceed 9.1 to 12.2 m (30 to 40 ft) (Bent 1953). Plants used for nesting include willows, alders, and other hydrophytic shrubs and trees (Bent 1953), including box-elders (*Acer negundo*) and cottonwoods (*Populus* spp.) (Schrantz 1943). In Iowa, dense thickets were frequently occupied by yellow warblers while open thickets with widely spaced shrubs rarely contained nests (Kendeigh 1941).

Males frequently sing from exposed song perches (Kendeigh 1941; Ficken and Ficken 1965), although yellow warblers will nest in areas without elevated perches (Morse 1966).

A number of Breeding Bird Census reports (Van Velzen 1981) were summarized to determine nesting habitat needs of the yellow warbler, and aclear pattern of habitat preferences emerged. Yellow warblers nested in less than 5% of census areas comprised of extensive upland forested cover types (deciduous or coniferous) across the entire country. Approximately two-thirds of all census areas withdeciduous shrub-dominated cover types were utilized, while shrub wetlands types received 100% use. Wetlands dominated by shrubs had the highest average breeding densities of all cover types [2.04 males per ha (2.5 acre)]. Approximately two-thirds of the census areas comprised of forested draws and riparian forests of the western United States were used, but average densities were low [0.5 males per ha (2.5 acre)].

Interspersion

Yellow warblers in Iowa have been reported to prefer edge habitats (Kendeigh 1941); Stauffer and Best 1980). Territory size has been reported as 0.16 ha (0.4 acre) (Kendeigh 1941) and 0.15 ha (0.37 acre) (Kammeraad 1964).

Special Considerations

The yellow warbler has been on the Audubon Society's Blue List of declining birds for 9 of the last 10 years (Tate 1981).

HABITAT SUITABILITY INDEX (HSI) MODEL

Model Applicability

Geographic area. This model has been developed for application within the breeding range of the yellow warbler.

Season. This model was developed to evaluate the breeding season habitat needs of the yellow warbler.

Cover types. This model was developed to evaluate habitat in the dominant cover types used by the yellow warbler. Deciduous Shrubland (DS) and Deciduous Scrub/Shrub Wetland (DSW) (terminolog follows that of U.S. Fish and Wildlife Service 1981). Yellow warblers only occasionally utilize forested habitats and reported populated densities in forests are low. The habitat requirements in forested habitats are not well documented in the literature. For these reasons, this model does not consider forested cover types.

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous that is required before an area will be occupied by a species. Information on the minimum habitat area for the yellow warbler was not located in the literature. Based on reported territory sizes, it is assumed that at least 0.15 ha (0.37 acre) of suitable habitat must be available for the yellow warbler to occupy an area. If less than this amount is present, the HSI is assumed to be 0.0.

Verification level. Previous drafts of the yellow warbler habitat model were reviewed by Douglass H. Morse and specific comments were incorporated into the current model (Morse, pers. comm.).

Model Description

Overview. This model considers the quality of the reproduction (nesting) habitat needs of the yellow warbler to determine overall habitat suitability. Food, cover, and water requirements are assumed to be met by nesting needs.

The relationship between habitat variables, life requisites, cover types, and the HSI for the yellow warbler is illustrated in Figure 1.

The following sections provide a written documentation of the logic and assumptions used to interpret the habitat information for the yelow warbler and to explain and justify and variable and equations that are used in the HSI model. Specifically, these sections cover the following: (1) identification of variables that will be used in the model; (2) definition and justification of the suitability levels of each variable; and (3) description of the assumed relationship between variables.

Reproduction component. Optimal nesting habitat for the yellow warbler is provided in wet areas with dense, moderately tall stands of hydrophytic deciduous shrubs. Upland shrub habitats on dry sites will provide only marginal suitability.

It is assumed that optimal habitats contain 100% hydrophytic deciduous shrubs and that habitats with no hydrophytic shrubs will provide marginal suitability. Shrub densities between 60 and 80% crown cover are assumed to be optimal. As shrub densities approach zero cover, suitability also approaches zero.

Figure 1. Relationship between habitat variables, life requisites, cover types, and the HSI for the yellow warbler.

Habitat variable	Life requisite	Cover types	
Percent deciduous shrub crown cover Average height of deciduous shrub canopy Percent of shrub canopy comprised of hydrophytic shrubs	Reproduction	Deciduous Shrubland Deciduous Scrub/ Shrub Wetland	HSI

Totally closed shrub canopies are assumed to be of only moderate suitability, due to the probable restrictions on movement of the warblers in those conditions. Shrub heights of 2 m (6.6 ft) or greater are assumed to be optimal, and suitability will decrease as heights decrease to zero.

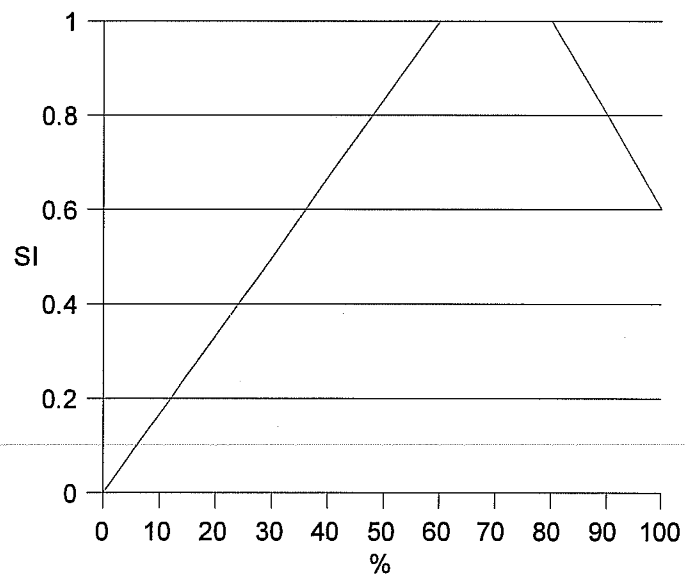
Each of these habitat variables exert a major influence in determining overall habitat quality for the yellow warbler. A habitat must contain optimal levels of all variables to have maximum suitabilityLow values of any one variable may be partially offset by higher values of the remaining variables. Habitats with low values for two or more variables will provide low overall suitability levels.

Model Relationships

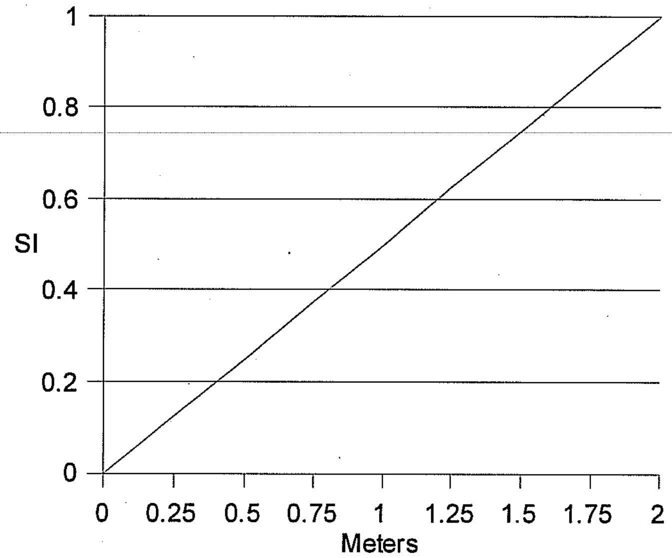
Suitability Index (SI) graphs for habitat variables. This section contains suitability index graphs that illustrate the habitat relationships described in the previous section.

Cover-type Variable

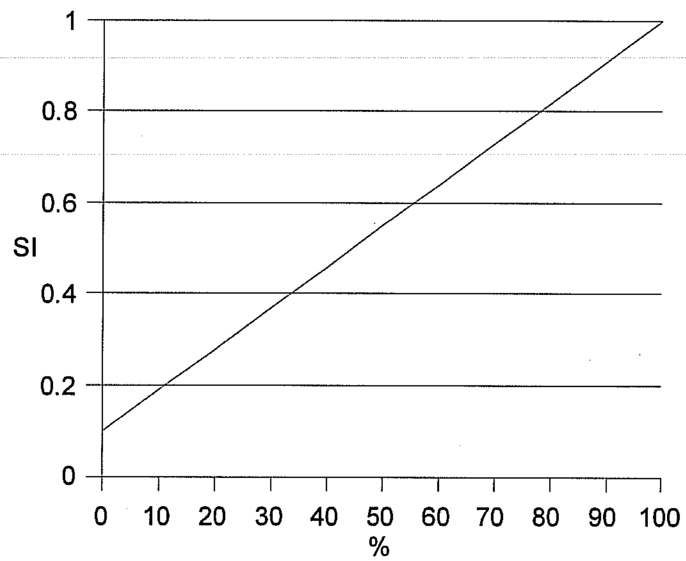
DS,DSW V_1 **Percent deciduous shrub crown cover.**



DS,DSW **V_2 Average height of deciduous shrub canopy.**



DS, DSW **V_3 Percent of deciduous shrub canopy comprised of hydrophytic shrubs**



Equations. In order to obtain life requisite values for the yellow warbler, the SI values for appropriate variables must be combined with the use of equations. A discussion and explanation of the assumed relationship between variables was included under Model Description, and the specific equation in this model was chosen to mimic these perceived biological relationships as closely as possible. The suggested equation for obtaining a reproduction value is presented below.

Life requisite	Cover type	Equation
Reproduction	DS,DSW	$(V_1 \times V_2 \times V_3)^{1/2}$

HSI determination. The HSI value for the yellow warbler is equal to the reproduction value.

Application of the Model

Definitions of variables and suggested field measurement techniques (Hays et al 1981) are provided in Figure 2.

Figure 2. Definitions of variables and suggested measurement techniques.

Variable (definition)	Cover types	Suggested techniques
V_1 Percent deciduous shrub crown cover (the percent of the ground that is shaded by a vertical projection of the canopies of woody deciduous vegetation which are less than 5 m (16.5 ft) in height).	DS,DSW	Line intercept
V_2 Average height of deciduous shrub canopy (the average height from the ground surface to the top of those shrubs which comprise the uppermost shrub canopy).	DW,DSW	Graduated rod
V_3 Percent of deciduous shrub canopy comprised of hydrophytic shrubs (the relative percent of the amount of hydrophytic shrubs compared to all shrubs, based on canopy cover).	DW.DSW	Line Intercept

SOURCES OF OTHER MODELS

No other habitat models for the yellow warbler were located.

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FWS/OBS-82/10.78
September 1984

HABITAT SUITABILITY INDEX MODELS: RED-WINGED BLACKBIRD

by

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This report should be cited as:

Short, H. L. 1985. Habitat suitability index models: Redwinged blackbird. U.S. Fish Wildl. Serv. Biol. Rep. 82(10.95). 20 pp.

PREFACE

This document is part of the Habitat Suitability Index (HSI) Model Series [Biological Report 82(10)] which provides habitat information useful for impact assessment and habitat management. Several types of habitat information are data that can be used to derive quantification relationships between key environmental variables and habitat suitability. This information provides the foundation for the HSI model and may be useful in the development of other models more appropriate to specific assessment or evaluation needs.

The HSI Model Section documents the habitat and includes information pertinent to its application. The model synthesizes the habitat use information into a framework appropriate for field application and is scaled to produce an index value between 0.0 (unsuitable habitat) and 1.0 (optimum habitat). The HSI Model Section includes information about the geographic range and seasonal application of the model, its current verification status, and a list of the model variables with recommended measurement techniques for each variable.

The model is a formalized synthesis of biological and habitat information published in the scientific literature and may include unpublished information reflecting the opinions of identified experts. Habitat information about wildlife species frequently is represented by scattered data sets collected during different seasons and years and from different sites throughout the range of a species. The model presents this broad data base in a formal, logical, and simplified manner. The assumptions necessary for organizing and synthesizing the species-habitat information into the model are discussed. The model should be regarded as a hypothesis of species-habitat relationships and not as a statement of proven cause and effect relationships. The model may have merit in planning wildlife habitat research studies about species, as well as in providing an estimate of the relative quality of habitat for that species.

ACKNOWLEDGMENTS

I gratefully acknowledge Dr. Gordon H. Orians, Department of Zoology, University of Washington, Seattle, for his review of this red-winged blackbird model . The cover of this document was illustrated by Jennifer Shoemaker. Word processing was provided by Carolyn Gulzow, Dora Ibarra, and Elizabeth Graf.

RED-WINGED BLACKBIRD (*Agelaius phoeniceus L.*)

HABITAT USE INFORMATION

General

The red-winged blackbird *(Agelaius phoeniceus L)* nests in fresh-water and brackish herbaceous wetlands, bushes and small trees along watercourses, and certain upland cover types from (American Ornithologists' Union 1983:723):

> ... east-central, south-coastal and southern Alaska..., southern Yukon westcentral and southern Mackenzie, northwestern and central Saskatchewan, central Manitoba, central Ontario, southern Quebec..., New Brunswick, Prince Edward Island, Nova Scotia and southwestern Newfoundland south to northern Baja California, through Mexico... and along both coasts of Central America to Nicaragua and northern Costa Rica .... and to southern Texas, the Gulf coast and southern Florida. [This blackbird winters] from southern British Columbia, Idaho, Colorado, Kansas, Iowa, the southern Great Lakes region, southern Ontario and New England... south throughout the remainder of the breeding range, with the southwestern and most of Middle American populations being sedentary.

The red-winged blackbird traditionally was considered to be a wetland nesting bird. It has adapted, within the last century, to habitat changes brought about by man; it now commonly nests in hayfields, along roadsides and ditches, and in other upland sites (Dolbeer 1980).

Food

Red-winged blackbirds vary their diet throughout the year, presumably in response to the nutritive demands of reproduction. The percent of waste grain and seeds in the diet of male blackbirds in one study in Ontario, Canada, was at least 80 to 87% in March and April, 46% in May, only 10% in July, and 85% in late July to October (McNicol et al. 1982). Insects amounted to 51 to 84% of the diet during May and July. The diet of female red-winged blackbirds varied between 67 and 79% insect parts in May and July but was only 15% insectivorous in late July-October, after fledging had occurred.

Water

References describing the dependency of the red-winged blackbird on surface water for drinking and bathing were not found in the literature. Nesting occurs in herbaceous wetlands and upland habitat near surface water and in suitable vegetation distant from free water. Red-winged blackbirds seem to prefer habitats near wetlands for foraging. Communal roosting, which occurs after fledging is completed, is either in herbaceous wetlands or dense communities of young trees with thick canopies growing on moist sites (Micacchion and Townsend 1983).

Cover

The red-winged blackbird nests in a variety of habitats. Blackbirds in southern Michigan prefer old and new hay fields, pastures, old fields, and wetlands with robust vegetation capable of supporting nests and dense cover that provides protection for nests (Albers 1978). They avoid cut or fallow fields, woodlots, agricultural croplands, open water, and tilled soil.

Areas with tall, dense, herbaceous vegetation seem to provide preferred nest sites. Blackbirds that nest early in the breeding season select tall, dense, old-growth herbaceous vegetation while blackbirds that nest late in the breeding season select tall, dense, new-growth herbaceous vegetation (Albers 1978). Upland nest sites of red-winged blackbirds in Ontario were in plant communities commonly dominated by goldenrod (*Solidago* spp.), alfalfa (*Medicago sativa*), fleabane (*Erigeron* spp.), clover (*Trifolium* spp.), various thistles (*Cirsium* spp.), and similar herbaceous weeds (Joyner 1978). Blackbirds in fresh water sites selected old- and new-growth of broad-leaved monocots, like cattails (*Typha* spp.) and broad-leaved sedges (*Carex* spp.), and commonly rejected old and new-growth of narrow-leaved monocots and forbs (Albers 1978). Woody species, such as hightide bush (*Iva* frutescens) and groundselbush (*Baccharis halimifolia*), and robust herbaceous plants, like cattails, supported the most nests in tidal herbaceous wetlands (Meanley and Webb 1963).

The density of preferred plant cover is not adequately described either in the literature or in this model. The height of preferred plant cover is inferred, below, from descriptions of nest sites.

Red-winged blackbirds frequently use scattered trees and fence posts near their breeding territories as observation posts. Blackbirds use both herbaceous wetlands and trees for communal roosts after fledging is completed. Roost trees characteristically are young, occur at high densities, provide thick canopies, and are adapted to moist sites (Micacchion and Townsend 1983).

Reproduction

Red-winged blackbirds are migratory in the northern portion of their range. Males migrate to or congregate at future nesting habitats in late winter, and females arrive at the territories in early spring (Case and Hewitt 1963). In areas with resident populations, individuals of both sexes may remain near breeding territories throughout the year, even though the areas are not actively defended or used in winter except, perhaps, as roosting sites (Orians pers. comm.). Males are polygynous, and up to six females commonly nest within a male's territory (Holm 1973). Harem size was larger in herbaceous wetlands with open stands of cattails than in herbaceous wetlands dominated by bulrushes (*Scirpus* spp.) or by closed stands of cattails (Holm 1973). Harem size has sometimes been observed to exceed 10 to 12 females and, in one instance, numbered 32 females (Orians pers. comm.).

Males do not participate in nest building, incubation, or feeding of the incubating female (Orians pers comm.). Males may help feed nestlings and are likely to help feed fledglings. The timing of breeding varies throughout the range of the red-winged blackbird. Nesting frequently begins in March or April and is completed by mid-July in the more temperate habitats. Most young in North America are fledged by late July.

Herbaceous wetlands dominated by cattails generally seem to be the most productive habitats for red-wing blackbirds in terms of nests/ha or number of young fledged/ha (Robertson 1972). Favorable herbaceous wetland sites produce more suitable food per unit area and have higher nest densities, highly synchronous nesting, higher nest survival rates. and lower nest predation rates than do upland nest sites.

Nests of red-winged blackbirds are placed on the edges of cattail clumps that border areas of open water (Wiens 1965). Herbaceous wetlands that are dominated by cattails and have open, permanent water have the optimum number of available nest sites. Early nests are placed in the old growth vegetation remaining from past growing seasons, while late nests may be built on new growth. Nest success in one herbaceous wetland habitat seemed related to: (1) increased depth of permanent water (up to 50 cm or more), which apparently reduced mammalian predation on nests; (2) nest placement close to water (greater nest success was observed for nests 20 cm above water than nests 100 cm above water), (3) nest placement in herbaceous wetland vegetation interspersed with open water, rather than in herbaceous wetland vegetation where no open water was present; and (4) nest placement in marsh grass and loosestrife (*Decadon verticillatus*), rather than in sweet gale (*Myrica gale*) and sedges (Weatherhead and Robertson 1977). Other studies have indicated that nests placed at 1.2 m heights were more successful than nests placed at 0.6 m heights in tidal herbaceous wetlands on Chesapeake Bay (Meanley and Webb 1963) and that nest success was higher when permanent water levels were greater than 25 cm (Robertson 1972).

Nests of red-winged blackbirds in upland sites typically are wound between and attached to stalks of herbaceous vegetation (Bent 1958). Early nests are entwined with old growth stems and late nests with the sturdiest stems of the new growth. Activities, such as intensive livestock grazing, mowing, and burning of old growth stubble, make herbaceous uplands unavailable for early nest placement. Mowing hayfields during the nesting season disrupts nesting success on upland sites (Albers 1978). Redwinged blackbirds seem to prefer areas with the densest, tallest herbaceous vegetation for nest placement. Vegetation that restricted visibility was more important than the number of plant stems and leaves per unit area. Trees greater than 5.0 m in height were in most territories (Albers 1978). The mean height of nest placement was 15 cm in monotypic stands of reed canarygrass (*Phalaris arundinacea*) 58 cm high (Joyner 1978). Nest sites often are close to open water (Joyner 1978), although no specific descriptions of acceptable distances of upland nest sites from open water were found in the literature.

Interspersion
The red-winged blackbird seems to be closely associated with the presence of standing water (Bent 1958) and certain types of dense herbaceous vegetation for nest placement. Herbaceous wetlands or sloughs I with extensive cattails, bulrushes, sedges, reeds (*Phragmites* spp.), or tules (*Scirpus* spp.), historically have provided important nesting habitatfor the blackbird (Bent 1958). However, blackbirds also nest in dense herbaceous cover in hayfields, along roadsides and ditches, and in other upland sites (Dolbeer 1980). Red-winged blackbirds forage for insects in understory, midstory, and overstory canopies (Snelling 1968) during the nesting season.

The blackbird is primarily a seed eater, except during fledging. The species sometimes forms large communal flocks in wetland herbaceous habitats or in trees and brushlands and these birds may forage on agricultural crops or understory seed sources (Mott et al. 1972; Johnson and Caslick 1982). After the autumn migration from the northern portion of their range, redwinged blackbirds frequently roost in herbaceous wetland habitats, trees, or shrubs and feed on seeds within understory vegetation.

Special Consideration
Red-winged blackbirds shift from a dispersed insectivorous feeding behavior during the nesting season to a communal granivorous feeding habit after fledging has occurred. They frequently move into agricultural areas at this time. Costsrelated to their consumption of grain can become high and may exceed the benefits of insect control related to their foraging habits during fledging (Bendell et al. 1981). Damage to ripening corn (*Zea mays*) occurs during August and September (Somers et al. 1981; Stehn and de Becker 1982), when blackbirds often congregate at night in herbaceous wetlands or in roosts in young deciduous trees in great concentrations (perhaps up to 1 million birds) (Stehn and de Becker 1982). The distance from these autumn roosts to corn fields and the proximity of corn fields to traditional flightlines strongly influences the amount of damage inflicted on individual corn fields. Bird damage to crops in Ohio diminished consistently as distances from communal roosts increased from 3.2 to 8 km, and the level of damage remained constant and low at distances of 8 to 19.2 km (Dolbeer 1980).

HABITAT SUITABILITY INDEX (HSI) MODEL
Model Applicability

Geographic area. This model will produce an HSI for nesting habitats of the redwinged blackbird. The breeding range and the year-round range of the blackbird occur throughout the contiguous 48 States.

Season. The model will produce an HSI for nesting habitat throughout the nesting seasons, which generally occurs from March to late July.

Cover types. This model was developed to evaluate habitat in herbaceous wetlands (HW) and upland herbaceous cover types, such as pasture and hayland (P/H), forbland (F), and grassland (G) (terminology follows that of U.S. Fish and Wildlife Service 1981).

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous habitat that is required before a species will live and reproduce in an area. Specific information on minimum areas required for red-winged blackbirds was not found in the literature. It is assumed, however, that a wetland area must contain at least 0.10 ha in emergent herbaceous vegetation, like cattails, to be considered nesting habitat for the blackbird. Several studies have described the minimum territory for male red-winged blackbirds as 0.02 ha (Weatherhead and Robertson 1977; Orians 1980). A 0.10 ha area of emergent herbaceous vegetation might, therefore, potentially provide territories for up to five male blackbirds. Territories in upland habitats are much larger than those in wetland habitats. It is assumed that a block of upland and habitat must be at least 1.0 ha in area to provide adequate breeding habitat for red-winged blackbirds.

Verification level. This model was developed from descriptive information about nesting cover and species-habitat relationships identified in the literature. The HSI derived from the use of this model describes the potential of an area for providing nesting habitat for the red-winged blackbird. The model is designed to rank the suitability of nesting habitat as would a biologist with expert knowledge about the reproductive requirements of the blackbird. The model should not be expected to rank habitats in the same way as population data because many nonhabitat-related criteria can significantly impact populations of wildlife species.

Model Description

Overview. The red-winged blackbird uses a variety of habitat layers throughout the year. Tall, dense, herbaceous vegetation seems to satisfy nesting, foraging, and cover requirements. The red-winged blackbird readily uses midstory and overstory layers of habitat at times but does not seem to be dependent on the presence of these layers.

The red-winged blackbird typically nests in tall (over 0.5 m), dense (undefined) herbaceous vegetation, although it occasionally nests in shrubs and trees. This nest site requirement is best met in herbaceous wetland habitats where nest sites are available in sturdy cattails over open, permanent water. Nesting requirements also can be met by suitable herbaceous vegetation in upland sites. Tall, sturdy, herbaceous stems or midstory or overstory components are used as display perches or observation posts. Red-winged blackbirds nesting in herbaceous wetland habitats may feed on insects associated with shrub, tree canopy, or herbaceous vegetation within the wetland or on insects associated with midstory and overstory canopies or in the grass understory outside the wetland boundary (Snelling 1968). Birds nesting in upland sites typically forage for insects in understory vegetation near the nest site.

This model attempts to evaluate the ability of a habitat to meet the food and reproductive needs of the red winged blackbird during the nesting season. The logic used in this species-habitat model is described in Figure 1. The following sections document this logic and the assumptions used to translate habitat information for the red-winged blackbird into the variables selected for the HSI model. These sections also describe the assumptions inherent in the model, identify the variables used in the model, define and justify the suitability level of each variable, and describe the assumed relationships between variables.

FIGURE 1

Food and reproductive components (herbaceous wetland cover types) There are three conditions (A, B, and C) included in Figure 1. Condition A wetlands, with a minimum of 0.10 ha in emergent herbaceous vegetation, can be very productive nesting habitats for red-winged blackbirds if water is present throughout the year, water chemistry is favorable for photosynthesis, and abundant, persistent, emergent vegetation suitable for nest placement is present. The quality of such a wetland as nesting habitat for red-winged blackbirds can be estimated with the following five habitat variables.

Variable 1 (V1) refers to the type of emergent herbaceous vegetation available in the wetland.

V1 = 1.0 if emergent herbaceous vegetation is predominantly old or new growth of broad-leaved monocots, like cattails.

V1 = 0.1 if emergent herbaceous vegetation is predominantly narrow-leaved monocots or other herbaceous materials.

Variable 2 (V2) considers the water regime of the wetlands. The suitability index of V2 is 1.0 if the wetland is permanently flooded or intermittently exposed with water usually present throughout the year. This is a desirable condition because permanent water is necessary to support persistent populations of invertebrates that overwinter in various larval instars, maximizing the production of aquatic insects that emerge throughout the next spring and early summer. These insects seem to be the favored food source for blackbirds nesting in herbaceous wetlands (Orians 1980). The presence of permanent water within the wetland may reduce mammalian predation on nests of red-winged blackbirds (Robertson 1972).

V2 = 1.0 if water usually is present in the wetland throughout the year.

V2 = 0.1 if the wetland usually is dry during some portion of the year.

Variable 3 (V3) pertains to the abundance of carp (*Cyprinus carpio*) within the wetlands. Carp disturb submergent vegetation within the wetlands, which may destroy habitat for emergent aquatic insects (like Odonates) and reduce wetland food sources for blackbirds.

V3 = 1.0 if carp are absent from the wetland.

V3 = 0.1 if carp are present within the wetland.

Variable 4 (V4) in the model measures the abundance of larvae of emergent aquatic insects. The adult form of these species provides a potentially important food source for red-winged blackbirds nesting in wetland habitats. The biomass of these benthic invertebrates is variable within a herbaceous wetland at any one time, as well as between sampling periods (Hynes 1972). This biomass should not be regarded as a direct measure of productivity because production, in terms of both numbers and weight, is many times larger than that present at any one sample periods, and the assessment of numbers or biomass per unit of area presents formidable, perhaps insurmountable, difficulties (Hynes 1972). The presence or absence of suitable benthic invertebrates can be determined by sampling with a sieve net (Needham and Needham 1970) along the edge of clumps of emergent vegetation. Sampling is more likely to be accurate than inferences about the presence of benthic invertebrates based on measures of water chemistry that may inadequately consider pollutants that impact aquatic food chains. Inferences about the presence of benthic invertebrates based on the appearance of aquatic vegetation also are less accurate than sampling (Orians pers. comm.). Therefore, sampling to determine the presence or absence of important benthic invertebrates is the preferred assessment technique.

V4 = 1.0 if larvae of damselflies and dragonflies (Order Odonata) are present in the wetland.

V4 = 0.1 if larvae of damselflies and dragonflies are not present in the wetland.

Dense stands of emergent vegetation in wetlands prevent sunlight from penetrating to the water surface, which reduces aquatic productivity. A mat of vegetation can form a wetland "floor", which reduces the availability of arthropods to red-winged blackbirds and may result in increased nest predation. Open water, interspersed throughout the emergent herbaceous vegetation, supports submergent vegetation within the wetland boundary that can be used by aquatic insects as food and cover. The openings also provide an interface between emergent vegetation and open water, which increases the vegetation surface area available to emerging insects and foraging red-winged blackbirds and may increase the presence of potential nest sites. Blackbirds frequently nest on the edge of cattail clumps that border open water (Wiens 1965). They are highly territorial, and the number of territories in a wetland is assumed to be dependent on the quantity of edge between emergent vegetation and open water that is available for nest sites. An exact measure of the amount of edge within a wetland can be difficult and unreliable because of the highly dynamic nature of the herbaceous vegetation, resulting from water level fluctuations, life cycles of the vegetation, and activities of animals like muskrats (*Ondatra zibethica*). Measures of the patchiness of emergent herbaceous vegetation and open water within a wetland is represented by variable 5 (V5) in the model.

Blackbirds prefer patchy stands of cattails interspersed with areas of open water over dense homogeneous stands of cattails (Robertson 1972). Variable 5 is assumed to have a suitability index of 1.0 when the quantity of open water and emergent vegetation is about even (about 40% to 60%). Robertson (1972) found a nesting density of about 96 nests/ha in herbaceous wetland habitat when patchy vegetation was about 41% of the total wetland area. Wetlands with large areas of emergent vegetation and small areas of open water receive relatively low SIs because of the small quantity of suitable nest sites. Case and Hewitt (1963) described the Inlet Valley Marsh in New York as a small, closed herbaceous wetland with upland trees and shrubs immediately adjacent for nesting and foraging sites. The redwinged blackbird nesting density in this herbaceous wetland was about 33/ha. Variable 5 is assigned an SI of 0.3 when a wetland is completely covered with emergent herbaceous vegetation, as described above.

Conditions where there are small areas of emergent vegetation and large areas of open water also receive a low SI because of the reduced availability of niche spaces. Moulton (1980) found redwinged blackbirds nesting in emergent vegetation along ditch banks that surrounded large areas of open water in rice (*Oryza sativa*) paddies in northern Minnesota. Nest densities averaged about 2.5 nests/ha of total wetland habitat, presumably because both nests and emergent vegetation were restricted to long, narrow strips of edge. The territorial behavior of red-winged blackbirds may have restricted the nest density along the ditch banks. An SI of 0.1 is assigned to V5 for wetland habitats with a limited amount of emergent herbaceous cover. The SI's for wetlands with different amounts of emergent herbaceous vegetation are listed below. User's can interpolate between listed values as needed.

V5 = 1.0 if the wetland area contains about an equal mix of emergent herbaceous vegetation and open water.

V5 = 0.3 if the wetland area is covered by a dense stand of emergent herbaceous vegetation.

V5 = 0.1 if the wetland area contains a few patches of emergent herbaceous vegetation and extensive areas of open water.

Condition B wetlands are wetlands that are likely to be dry sometime during the year or that do not have an aquatic insect resource. These wetlands may still provide some habitat for nesting redwinged blackbirds. Blackbirds will tend to use the available emergent vegetation as nest sites and rely on vegetation surrounding the wetland as a foraging substrate. The distance that redwinged blackbirds will fly from wetlands to forage on insects in upland habitats is not known. In this model, only foraging sites within 200 m of wetlands that contain nest sites are assumed to be useful to blackbirds. The quality of a wetland without permanent water or an aquatic insect resource is assumed to be no better than the quality of available foraging sites outside the wetland (V6). Wetlands that only have upland habitats with understory vegetation (such as old fields, pastures, or hay fields) available as foraging substrates are given an SI of 0.1. Wetlands near uplands that have a deciduous midstory or tree canopy as a foraging substrate are assumed to have an SI of 0. 4. Red-winged blackbirds nesting in one herbaceous wetland will forage on insects in other, close-by, herbaceous wetlands (Holm 1973). Condition B wetlands situated within 200 m of a condition A herbaceous wetland that has an emergent aquatic insect fauna (Odonates) and undefended foraging areas are given an SI of 0.9.

V6 = 0.1 if the only suitable foraging substrate is an understory layer.

V6 = 0.4 if the suitable foraging substrates include a midstory and/or an overstory layer.

V6 = 0.9 if the suitable foraging area is a condition A wetland.

<u>Food and reproductive components (upland cover types)</u>. Upland habitats (Fig. 1; condition C) frequently are less productive than are wetland habitats. The number of young redwinged blackbirds fledged per territory may be as large in upland sites as in some wetland habitats (Dolbeer 1976). The number of young fledged/ha in upland sites, however, frequently is less than 10% of the number fledged/ha in good quality wetland habitat. For example, Robertson (1972) reported 133 young fledged/ha in one wetland study area, while only 5 young fledged/ha in nearby upland sites. The nesting density in the wetland habitat, with patches of emergent, herbaceous vegetation interspersed with patches of open water, was about 10 times

higher than in upland habitats. Robertson found about 100 redwinged blackbird nests/ha in suitable wetland habitat, 2 to 13 nests/ha in hay fields, and 0.1 nests/ha in a Christmas tree plantation.

Robertson's (1972) data on the numbers of nests/ha and young fledged/ha suggest that, if the best wetland habitats have an HSI of 1.0, the best upland sites may have an HSI of about 0.1. Graber and Graber (1963) determined that summer populations of redwinged blackbirds (number/40 ha) in Illinois from 1958 to 1959 were 301 birds in herbaceous wetlands (whether condition A or B is unknown), 342 birds in edge shrubs, 204 birds in sweet clover, 158 birds along drainage ditches, 134 birds in mixed hay, 89 birds in red clover (*Trifolium pratense*), 65 birds in oat (*Avena sativa*) fields, 64 birds in ungrazed grasslands, 58 birds in alfalfa, 30 birds in wheat (*Triticum aestivum*), 27 birds in fallow fields, 24 birds in pastureland, 23 birds in shrub-grown areas, 5 birds in corn fields, and 3 birds in soybeans (Glycine max). The observed nest densities would not exceed the values measured by Robertson (1972) for upland habitats even if all of the birds in each of these different habitat types were nesting females.

The type of upland cover available as nest sites for the redwinged blackbird is represented by V7 in the model. Red-winged blackbirds nest in a wide variety of upland sites. For example, blackbirds nested in hay fields and old fields, but not in tilled and fallow fields, in southern Michigan (Albers 1978). Important characteristics of upland nest sites include the presence of dense, tall, herbaceous vegetation, the availability of fence posts and other structures that serve as display perches for males and as observation posts for both males and females, and a proximity to open water (Joyner 1978). Specific information on the preferred proximity of nest sites in upland habitats to open water were not found in the literature.

Variable 7 (V7) describes the availability of dense, sturdy herbaceous vegetation in forbland, grassland, and pasture/hayland upland sites. Variable 7 has a habitat suitability index of 0.1 if the herbaceous vegetation is dense and tall, like sweet clover (Melilotus spp.), mixed hay, alfalfa, and coarse weeds, which provide suitable nest sites and protective cover. Variable 7 has a suitability index of 0.0 if the habitat site has some other surface cover, such as cut or fallow fields, agricultural fields, woodlots, or tilled soils.

V7 = 0.1 if upland habitat provides dense, tall, herbaceous vegetation.
V7 = 0.0 if upland habitat has some other surface cover.

Early nests of red-winged blackbirds in upland sites are more productive than are late nests (Dolbeer 1976). Early nests are placed in robust, dense, old herbaceous growth. Activities that are destructive to this vegetation, such as mowing, heavy grazing pressure, or burning, reduce habitat suitability for red winged blackbirds. The occurrence of disturbances that might impact nesting success in upland cover types is included as V8 in the model.

V8 = 0.1 if disturbances, such as mowing, heavy grazing, or burning, do not occur to the potential habitat site in most years.

V8 = 0.0 disturbances occur to the potential habitat site in most years

HSI determination. Three types of habitat conditions (A, B, and C) are described in Figure 1. Condition A represents a wetland that contains the preferred vegetative structure for nest placement, permanent water that supports a population of emergent aquatic insects that are available as food, the absence of carp, and the interspersion of open water within emergent herbaceous vegetation. The equation combining the SIs for VI to VS to estimate an HSI for condition A wetlands is:

HSI = (V1 x V2 x V3 x V4 x V5)

Condition B habitats (Fig. 1) are wetlands where the emergent herbaceous vegetation does not have the preferred structure, there is no permanent water, carp are present, or benthic invertebrates are absent. Condition B habitats have a basic SI of0.1, determined by the 0.1 SI for the unsuitable conditions of V1, V2, V3, or V4. The basic SI of 0.1 can be increased if suitable foraging substrate is available outside the boundary of the wetland. Food sources are considered more limiting if only an nderstory layer is available than if deciduous midstory and/or overstory layers also are available as foraging surfaces. A condition B habitat may be of highest value to redwinged blackbirds if the birds can readily feed on emergent aquatic insects in a nearby condition A herbaceous wetland habitat. The equation for estimating the HSI for condition B habitats is:

$$HSI = (0.1 \times V6)^{1/2}$$

Condition C habitats are upland sites, like grass, forb, and pasture/hayland cover types. Their HSI'S, which will be either 0.1 or 0, are described by the following equation:

$$HSI = (V7 \times V8)^{1/2}$$

The measure of habitat quality represented by the HSI actually reflects an estimate of the quantity of niche space available to the blackbird. Habitats with higher HSIs are asumed to contain more niche space than habitats with lower HSI'S. More niche space in a habitat frequently means that more individuals will occur in that habitat.

Application of the Model

Summary of model variables This model can be applied by interpreting a recent, good quality, aerial photograph of the assessment area and making selected field measurements. The habitat to be evaluated is outlined on the aerial photograph. Each wetland within the assessment area is identified and a 200 m zone drawn around its perimeter. The wetlands within the assessment area are evaluated, on a per ha basis, with field observations and measurements that determine: (1) the type of emergent vegetation present; (2) the probable permanency of the water; (3) the presece or absence of carp; (4) the presence or absence of larval stages of emergent aquatic insects; (5) the mix of open water and emergent herbaceous vegetation; and (6) the nature of vegetative cover within 200 m surrounding the wetland (Fig. 2). The proprtion of open water and emergent herbaceous vegetation within the wetland is estimated from a map made after boating or wading through the wetland. The presence of benthic invertebrates is determined from field sampling. Upland habitats within the assessnent area are evaluated by ground truthing to determine cover types and land-use practices. Habitat conditions, like the presence of dense, tall herbaceous cover and the probability that disturbances such as grazing, burning, mowing, and tilling will occnduring the March to July nesting season, are noted.

Definitions of variables and suggested field measurement techniques are provided in Figure 3.

Model assumptions. I have assumed that it is possible to synthesize results from many studies conducted in different seasons of the year different locations in North America into a model years, and a wide variety of nest sites throughout North America into a model describing the relative quality of breeding habitat for the red-winged blackbird. My basic assumptions about habitat criteria important to redwinged blackbirds are based on descriptive and correlative relationships expressed in the literature. My descriptors of habitat quality will obviously be in error if authors made incorrect judgements or mesurements or if I have emphasized the wrong data sets or misinterpreted the meaning of published data.

I have assumed that the quality of some wetland habitats exceeds the quality of best upland habitats. This assumption was based largely on quality of the blackbirds fledged per hectare of wetland and upland habitats. I compiled and analyzed characteristics of wetland habitats that seemed to distinguish habitats where varying numbers of red-winged blackbirds were fledged. I assumed that I could meaningfully bound the size of study areas to be evaluated as nesting habitat as $\geq$ 0.1 ha for wetland sites and ∃ 1.0 ha for suitable upland sites. I arbitrarily selected distances (200 m) that blackbirds might fly from their nests in wetlands to forage on insects and seeds in surrounding vegetative cover. I assumed that the presence of dense, tall, herbaceous cover reasonably close to water, coupled with a strong probability that the dense cover would remain relatively undisturbed during the breeding season, would adequately indicate the value of upland habitats as nest sites for the red-winged blackbird.

The values for Variables 1 through 8 are estimates. The ecological information available does not seem sufficient to suggest: (1) other pertinent variables; (2) more appropriate values for the present variables; or (3) more definitive interrelationships between the variables. Finally, I have assumed that the multiplicative relationship described in the model is appropriate summary statement to provide a Habitat Suitability Index that reflects the relative importance of different habitats as nest sites for the red-winged blackbird.

Figure 3. Definitions of variables and suggested measurement techniques.

Variable (definition)		Cover type	Suggested technique
VI	Type of emergent	HW	Identify the dominant species of emergent herbaceous vegetation in the wetland. Determine if the dominant species is a broad-leaved monocot.
V2	Water regime	HW	Determine whether or not water will be retained in the wetland throughout the year in most years; use, if possible, indicators like muskrat houses and fish. Evaluate records describing permanence and level of water in wetland. Determine the classification type of wetland if the wetland has been classified.
V3	Abundance of carp within the wetland.	HW	Determine presence of carp by seining, using local data about presence of carp within wetland or observations to see if water is clear or generally murky, as it is when carp are feeding.
V4	Abundance of larval	HW	Collect insect larvae by dragging astages of emergent aquatic sieve net along water bottom near edge insects(Order Odonata) of clumps of emergent herbaceous within the wetland. vegetation. Sampling is done for some fixed time period. A second sampling procedure involves kicking up the

			substratum at the edge of clumps of emergent herbaceous vegetation in front of the mouth of a net in some standardized manner (Hynes 1972:240). The collected invertebrates are sorted and identified by comparison with illustrations in an appropriate manual (like Needham and Needham 1970) to determine the presence of damselfly and dragonfly larvae (Order Odonata).
V5	Percent emergent	HW	Determine the mix of open water and herbaceous canopy emergent herbaceous vegetation within the wetland study area. Estimate the mix from a map prepared after wading, walking or boating through the wetland or from a map made from a recent, high quality, aerial photograph
V6	Types of foraging sites	HW	Use map measurer (Hays et al. 1981) available outside the wetland. to determine if another wetland with an emergent aquaticinsect population occurs within 200 m of nest sites within the wetland being evaluated. Map vegetation within 200 m of the wetland and determine, using a dot grid (Hays et al. 1981) or a planimeter, if deciduous midstory and overstory layers comprise atleast 10% cover when projected to the ground surface. If midstory and/or overstory do not provide at least 10% cover, and a condition. A wetland does not occur within 200 m of the wetland being evaluated assume only the understory layer is available as a foraging substrate.
V7	Presence of dense, sturdy	F,G,P/H	Interpret the aerial photograph or a herbaceous vegetation Vegetation on-site map prepared from the aerial photograph to determine areas of upland herbaceous vegetation. Ground truth to determine types of herbaceous vegetation occurring in the upland within the assessment area and determine if tall, dense, herbaceous cover covers at least 10% of the surface area.
V8	Occurrence of disturbances	F,G,P/H	Ground truth to predict past and future like grazing, mowing, burning, land-use practices (types of and tilling on potential uplanddisturbances that may impact nesting nest sites. success).

SOURCES OF OTHER MODELS

Weatherhead and Robertson (1977) identified and quantified some parameters that affected the nesting success of red-winged blackbirds in wetland habitats in Ontario, Canada. They determined that nesting success, as judged by numbers of young fledged per female, was positively correlated with territory quality scores based on nest placement. Nesting success seemed to be related to four parameters: (1) water depth within the wetland; (2) height of nest above the herbaceous wetland floor; (3) relative openness of nesting cover within the wetland; and (4) the identity of the support vegetation holding the nest. Two of these variables are represented in the present model of habitat suitability for the redwinged blackbird: (1) presence or absence of permanent water; and (2) the relative openness of vegetation within flooded herbaceous wetlands. No other models for use in predicting the quality of nesting habitat for redwinged blackbirds were found in the literature.

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FWS/OBS-82/10.78
September 1984

HABITAT SUITABILITY INDEX MODELS: GREAT EGRET

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This report should be cited as:

Chapman, B.R., and R. J. Howard. 1984. Habitat suitability index models: great egret. U.S. Fish Wildl. Serv. FWS/OBS-82/10.78. 23 pp.

PREFACE

The habitat suitability index (HSI) model for the great egret presented in this report is intended for use in the habitat evaluation procedures (HEP) developed by the U.S. Fish and Wildlife Service (1980) for impact assessment and habitat management. The model was developed from a review and synthesis of existing information and is scaled to produce an index of habitat suitability between 0 (unsuitable habitat) and 1.0 (optimally suitable habitat). Assumptions used to develop the HSI model and guidelines for model applications, including methods for measuring model variables, are described.

This model is a hypothesis of species-habitat relations, not a statement of proven cause and effect. The model has not been field tested, but it has been applied to three hypothetical data sets that are presented and discussed. The U.S. Fish and Wildlife Service encourages model users to convey comments and suggestions that may help increase the utility and effectiveness of this habitat-based approach to fish and wildlife management. Please send any comments or suggestions you may have on the great egret HSI model to the following address.

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ACKNOWLEDGMENTS

Earlier versions of the habitat suitability index model and narrative for the great egret were reviewed by Dr. R. Douglas Slack and Jochen H. Wiese. The model's structure and functional relationships were thoroughly evaluated by personnel of the U.S. Fish and Wildlife Service's (FWS) National Coastal Ecosystems Team. Model and narrative reviews were also provided by FWS Regional personnel.

GREAT EGRET (*Casmerodius albus*)

INTRODUCTION

The great egret, also called common egret or American egret, is a large white heron in the order Ciconiiformes, family Ardeidae. Great egrets stand 37-41 inches tall and have a wing spread to 55 inches (Terres 1980). The species is associated with streams, ponds, lakes, mud flats, swamps, and freshwater and salt marshes. The birds feed in shallow water on fishes, amphibians, reptiles, crustaceans and insects (Terres 1980).

Distribution

The great egret is a common breeding species in all coastal areas south from southern Oregon on the Pacific coast and from Maine on the Atlantic coast; in riverine, palustrine and estuarine habitats along the coast of the Gulf of Mexico; and in the Eastern-Central United States (Palmer 1962; Erwin and Korschgen 1979; American Ornithologists' Union 1983). The great egret undergoes an extensive postbreeding dispersal that extends the range of the species to most of the United States exclusive of the arid Southwest (Byrd1978). Young birds hatched in Gulf coast colonies tend to move northward for a short period (Byrd 1978; Ogden 1978). However, with the onset of colder weather most great egrets and other herons migrate south and many winter along the gulf coast in Texas, Louisiana, and Florida (Lowery 1974; Oberholser and Kincaid 1974; Byrd 1978). Analysis of banding data indicates that many birds winter in Cuba, the Bahamas, the Greater and Lesser Antilles, Mexico, and Central America (Coffey 1948). Lowery (1974) suggested that during severe winters, a higher proportion of the population winters farther south.

Life History Overview

Great egrets nest in mixed-species colonies that number from a few pairs to thousands of individuals. A colony may include other species of herons, spoonbills, ibises, cormorants, anhingas, and pelicans. Colony and nest-site selections begin as early as December along the gulf coast, but most great egrets do not initiate nesting activities until mid-February or early March (Bent 1926; Oberholser and Kincaid 1974; Chaney et al. 1978; Morrison and Shanley 1978). Eggs have been recorded from March through early August, and young have been observed in nests from mid-May through late August (Oberholser and Kincaid 1974; Chaney et al. 1978). Clutch size varies from one to six eggs per nest, but three to four eggs is most common (Bent 1926). Incubation period in a Texas colony ranged from 23 to 27 days (Morrison and Shanley 1978). The first flights of young have been noted about 42 days after hatching (Terres 1980).

SPECIFIC HABITAT REQUIREMENTS

Food and Foraging Habitat

Fish constitute up to 83% of the great egret's diet (Hoffman 1978). Most fish taken by great egrets are minnow-sized 3.9 inches, but fish up to 14 inches can be captured and swallowed (Willard 1977; Schlorff 1978). Other major food items include insects, crustaceans, frogs, and snakes, while small mammals, small birds, salamanders, turtles, snails, and plant seeds are occasionally taken (Baynard 1912; Bent 1926; Hunsaker 1959; Palmer 1962; Genelly 1964; Kushlan 1978b).

Little specific information exists on the food habits of various age classes of great egrets. An adult great egret weighing 32.3 ounces (oz) (Palmer 1962) may require approximately 3.9 oz of food per day (estimated by using the wading bird weight-daily food requirement model proposed by Kushlan 1978b). Daily food requirements are undoubtedly higher during the nesting season when adults are feeding young (Kushlan 1978b).

Great egrets usually forage in open, calm, shallow water areas near the margins of wetlands. They show no preference for fresh-, brackish, or saltwater habitat. Custer and Osborn (1978a,b) found that feeding habitat selection in coastal areas of North Carolina varied daily with the tidal cycle. During low tide, great egrets fed in estuarine seagrass beds. During high tide, freshwater ponds and the margins of *Spartina* marshes were used. Inland, great egrets feed near the banks of rivers or lakes, in drainage ditches, marshlands, rain pools (Bent 1926; Dusi et al.

1971; Kushlan 1976b), and occasionally in grassy areas (Weise and Crawford 1974). Feeding sites are generally not turbid and are fairly open with no vegetative canopy and few emergent shoots (Thompson 1979b).

Great egrets forage singly, in single-species groups, and in mixed-species associations (Kushlan 1978b). Great egrets generally fly alone to feeding sites (Custer and Osborn 1978a,b) and may use the same feeding site repeatedly. The density and abundance of fish at a given location in estuarine habitats may vary with season, time of day, tidal stage, turbidity, and other factors. If feeding success is low, great egrets may move to other areas (Cypert 1958; Schlorff 1978) and join other conspecifics in good feeding habitats (Custer and Osborn 1978a,b). Most instances of group feeding have been observed during specific environmental conditions, such as lowered water levels, that tend to concentrate prey (Kushlan 1976a,b; Schlorff 1978).

Meyerriecks (1960, 1962) and Kushian (1976a, 1978a, b) provided detailed information on hunting techniques employed by great egrets. The "stand-and-wait" and "slow-wade" methods are used most frequently. Because of their long legs, great egrets can forage in somewhat deeper water than most other herons. In New Jersey, foraging depths ranged from 0 (standing on the bank while fishing) to 11 inches, but depths ranging from 4 to 9 inches were most commonly used (Willard 1977). In North Carolina, great egrets fed in water with a mean depth of 25.1 cm (9.8 inches) in *Spartina* habitat and of 6.8 inches in non-*Spartina* habitat (Custer and Osborn 1978b). Mean water depth was 7.9 inches for foraging great egrets in California (Hom 1983). In addition to wading, great egrets can feed by alighting on the surface of deep waters to catch prey, a method rarely employed (Reese 1973; Rodgers 1974, 1975).

Although recent declines of great egret populations in the central coastal region of Texas occurred simultaneously with declines in coastal marine and estuarine fish populations (Chapman 1980), no causal relationship has been proven. At present there are no known management practices that provide suitable food alternatives for piscivorous species, such as the great egret, during periods of fish population decline. Known fish nursery and feeding areas need protection from destruction or habitat alteration to ensure adequate prey populations for fish-eating birds.

Water

The physiologic water requirement of great egrets is probably met during feeding activities in aquatic habitats (Dusi et al . 1971). Water depth affects the quantity, variety, and distribution of food and cover; great egret food and cover needs are generally met between the shoreline and water 1.6 feet deep (Willard 1977).

Interspersion

Suitable habitat for the great egret must include (1) extensive shallow, open water habitat from 4 to9 inches deep (Willard 1977); (2) food species present in sufficient quantity (Custer and Osborn 1977); and (3) adequate nesting or roosting habitat close to feeding habitat. Most great egrets at a colony in North Carolina flew less than 2.5 miles from nesting colonies (and presumably, from roosting sites) to feeding areas (Custer and Osborn 1978a), but flight distances of up to 22.4 miles have been recorded in the floodplain of the Upper Mississippi River (Thompson 1979b).

Several heronries may be close together. Great egrets from one colony may fly over or near an adjacent colony, but rarely feed in the same areas as conspecifics from the adjacent colony (Thompson 1979b).

HABITAT SUITABILITY INDEX (HSI) MODELS

Model Applicability

Geographic area. The habitat suitability index (HSI) models in this report were developed for application in coastal wetland habitats in Texas and Louisiana. Because there are few differences in habitat requirements along the Atlantic coast, the remainder of the gulf coast, and inland sites in the Southeastern United States, the HSI models may also be used to evaluate potential habitat in those areas.

Season. This model will produce an HSI values based upon habitat requirements of great egrets during the breeding season (February to August). Because there is no apparent seasonal difference in feeding habitat preference and because winter nocturnal roosts are similar to nesting sites, the HSI models may also be used to evaluate winter habitat for the great egret.

Cover types. Great egrets nest on upland islands and in the following cover types of Cowardin et al. (1979): Estuarine Intertidal Scrub-Shrub wetland (E2SS), Estuarine Intertidal Forested wetland (E2FO), Palustrine Scrub-Shrub wetland (PSS) (including deciduous and evergreen subclasses), and Palustrine Forested wetland (PFO) (including deciduous and evergreen subclasses). Great egrets may also feed in these wooded wetlands, but preferred feeding areas may be any one of a wide variety of wetland cover types.

Minimum habitat area. Minimum habitat area is defined as the minimum amount of contiguous suitable habitat required before an area can be occupied by a particular species. Specific information on minimum areas required by great egrets was not found in the literature. If local information is available to define the minimum habitat area, and less than this amount of area is available, the HSI for the species will be zero.

Verification level. The output of these HSI models is an index between 0 and 1.0 thatis believed to reflect habitat potential for great egrets. Two biologists reviewed and evaluated the great egret HSI model throughout its development: Dr. R. Douglas -Slack, Texas A&M University, College Station, and Jochen H. Wiese, Environmental Science and Engineering Company, Gainesville, Florida. Their recommendations were incorporated into the model building effort. The authors, however, are responsible for the final version of the models. The models have not been field-tested.

Model Descriptions

Feeding HSI model. Great egret feeding habitat suitability is related to prey availability. Habitat suitability is optimal when two conditions are met: (1) the populations of minnow-sized fish are high; and (2) shallow open water (necessary for successful prey capture), aquatic vegetation (necessary for prey survival and reproduction), and deeper water are present in a ratio that maximizes prey density and minimizes hunting interference. Use of this model assumes that deep or permanent water environments are not limiting in coastal habitats and that fish populations are distributed uniformly. Because great egrets hunt a variety of species in many different habitat types, a general approach to modeling feeding habitat suitability is presented. Suitability of all wetland cover types for feeding is determined by integrating two factors: (1) the abundance of prey and (2) the accessibility of prey.

The abundance of prey is determined by the ability of the habitat to support the major prey species, especially minnow-sized fish. It is assumed that the abundance of major prey species is related to the primary and secondary productivity of the aquatic habitat; however, few field studies have documented this relationship. The model assumes that prey abundance is not limiting in coastal habitats. Therefore, the accessibility of prey is used as the indicator of feeding habitat suitability.

The accessibility of prey is determined by water depth and percentage cover of aquatic vegetation. A wetland with 100% of its area covered by water 4-9 inches deep is assumed to be optimal for feeding by great egrets (V_1). Although an absence of submerged or emergent vegetation would render fish species most vulnerable to capture, it is unlikely that many prey species would use such an area because it totally lacks cover. The model assumes, therefore, that optimal conditions for both the occurrence and susceptibility to capture of prey species exist when 40%-60% of the wetland substrate is covered by submerged or emergent vegetation (V_2). When such vegetation is lacking, the habitat has a low value for feeding great egrets because small fish may use unvegetated water that is too shallow for their larger aquatic predators.

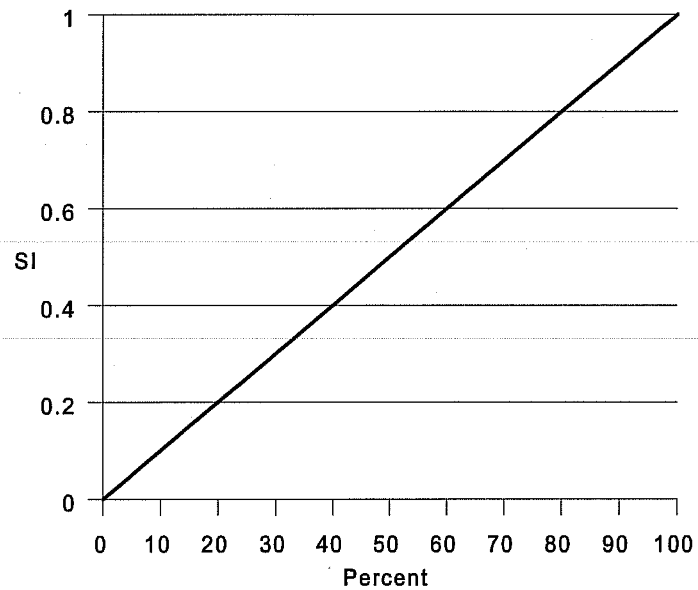
	Habitat variable	Component	
V_1	Percentage of area with water 10-23 cm deep.	Food	HSI (Feeding)
V_2	Percentage of submerged or emergent vegetation cover in zone 10-23 cm deep.		

Suitability Index (SI) Graphs for Model Variables

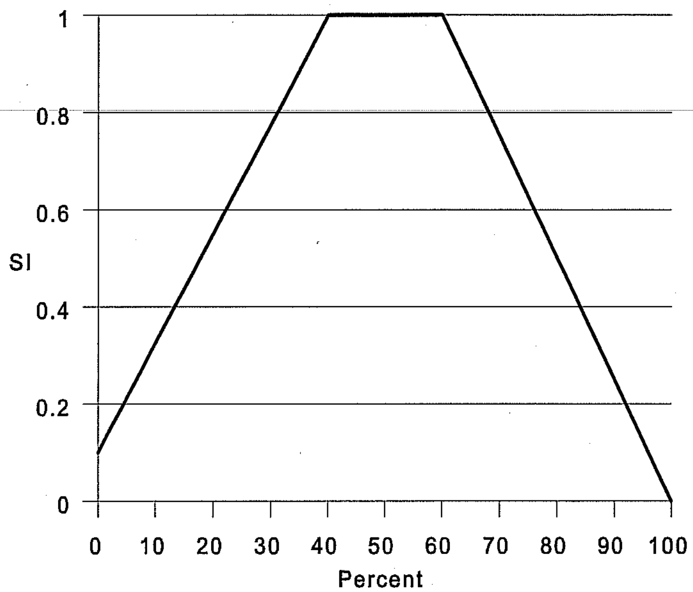
This section provides graphic representation of the relationship between habitat variables and habitat suitability for the great egret in wetland (see Table 2 for abbreviations) and upland (U) cover types. The SI values are read directly from the graph (1.0 = optimal suitability, 0.0 = no suitability) for each variable.

The SI graphs are based on the assumption that the suitability of a particular variable can be represented by a two dimensional linear response surface. Although there may be interdependencies and correlations between many habitat variables, the model assumes that each variable operates independently over the range of other variables under consideration.

V_1 Percentage of study area with water 4-9 inches deep. In tidal areas, use depth at mean low tide. In nontidal areas, use average summer conditions.



V_2 Percentage of substrate in zone 4-9 inches deep covered by submerged or emergent vegetation.



Feeding HSI.

$$HSI = \frac{V_1 + V_2}{2}$$

Data representing three hypothetical study areas for great egret were used to calculate sample HSI values The HSI values obtained are believed to reflect the potential of the areas to support feeding or nesting geat egrets.

Field Use of Models

The level of detail needed for application of these models will depend on time, money, and accuracy constraints. Detailed field sampling of all variables will provide the most reliable and replicable HSI values. Any orall variables can be estimated to reduce the amount of time or money required to apply the models. Increased use of the subjective estimates decreases reliability and replicability, and these estimates should be accompanied by appropriate documentation to insure that decision makers understand both the method of HSI determination and quality of data used in the model. Techniques for measuring habitat variables included in the great egret HSI models are suggested in Table 5.

A project area may contain both potential feeding and nesting habitat. To decrease the cost and time necessary to evaluate the area, assume that food is not limiting and apply only the nesting HSI model. This recommendation is based upon the following assumptions: (1) in most coastal areas of Texas and Louisiana, aquatic habitats suitable for feeding are abundant and are, therefore, less of a limiting factor to great egrets than are suitable nesting sites; and (2) nesting value is easier and more accurately estimated by using subjecive methods than is food value. The variables used to measure food use of past colony sites, and (2) the enhancement of a site by the presence of other herons. These two factors are usually, but not always, interrelated. Great egrets tend to use the same colony site in successive years until the site is degraded, and the site may include great blue herons. When applying the HSI model , the user should be aware that an area known to be used by great egrets (or great blue herons) is more likely to be used in future years than an area with an equal HSI value not known to have a history as a colony site.

Table 5. Suggested measurement techniques for habitat variables used in the great egret HSI models.

Variable	Suggested technique
V_1	The percentage of the area with water 4-9 inches deep can be determined by line transect sampling of water depth.
V_2	The percentage of substrate in the 4-9 inches water depth zone covered by submerged or emergent vegetation can be determined from available cover maps, aerial photographs, or by line transect sampling.

HABITAT SUITABILITY INDEX MODEL

CALIFORNIA VOLE (*Microtus californicus*)

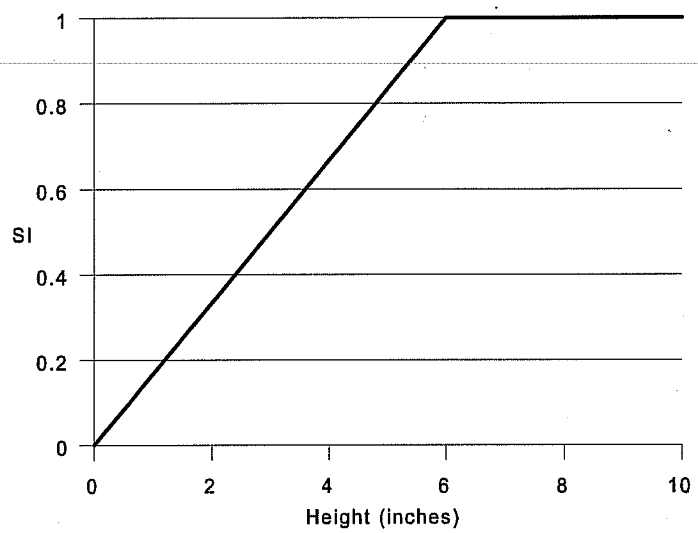
U.S. Fish and Wildlife Service
Division of Ecological Services
Sacramento, California

Cover-Type	Life Requisite	Habitat Variable
Annual Grassland Seasonal Wetland	Food/Cover Reproduction	Height of herbaceous vegetation (V1) Percent cover of herbaceous vegetation (V2) Soil Type (V3)
Riparian Woodland Oak Woodland	Reproduction Food/Cover	Height of herbaceous vegetation (V1) Percent cover herbaceous vegetation (V2) Soil Type (V3) Presence of logs and other types of cover (V4)

Variable	Cover-Type	Sampling Technique
V1 - Height of herbaceous	Annual Grassland Oak Woodland Riparian Woodland Seasonal Wetland	Average vegetation height in 1 m^2 quadrat
V2 - Percent cover of herbaceous vegetation	Annual Grassland Seasonal Wetland Oak Woodland Riparian Woodland	1 m^2 quadrat
V3 - Soil Type	Annual Grassland Seasonal Wetland Oak Woodland Riparian Woodland	Site inspection County Soil Survey
V4 - Presence of logs and other types of cover	Annual Grassland Seasonal Wetland Oak Woodland Riparian Woodland	Visual inspections Sample point

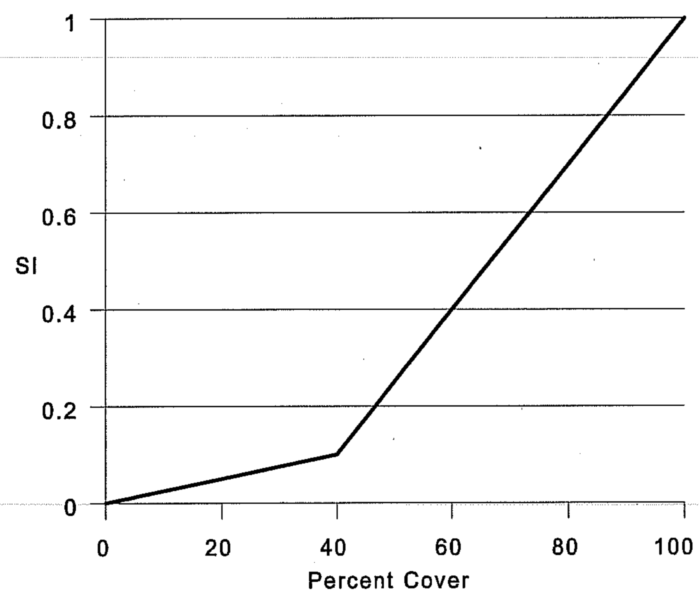
Variable 1: Height of herbaceous vegetation.

Assumes: California voles require relatively tall herbaceous vegetation for both food (Gill 1977. Batzil 1986) and cover (Ingles 1965). Herbaceous vegetation ≥ 6 in tall is considered optimum.



Variable 2: Percent cover of herbaceous vegetation.

Assumes: Relatively dense herbaceous vegetation is needed for cover percent cover≥ 100 percent is considered optimum (CDFG undated).



Variable 3: Soil type

Assumes: Friable soils such as silts and loams are optimum because voles can dig their burrows (Ingles 1965). Soils such as sands and clays are not optimum.

Suitability Index (SI)

SI = 1.0 if soil type is silty or loamy and friable.

SI = 0.5 if soil type is not silty or loamy and is moderately friable

SI = 0.2 if soil type is not silty or loamy and is not friable.

Variable 4: Presence of logs and other cover types within the sample area.

Assumes: California voles will use logs, brush piles, and rocks for cover in addition to their burrows (California Department of Fish and Game). These sources of cover are more important in woodland habitats than grassland and wetland habitats.

SI = 1.0 logs, brush piles, and rocks are abundant and well distributed throughout the sample site (e.g., ≥ 4 per sample site).

SI = 0.7 if logs, brush piles, and rocks are moderate abundant and distributed throughout the sample site (e.g., 2-4 per sample site).

SI = 0.4 logs, brush piles, and rocks are absent or sparsely distributed throughout the sample site (≤ 1 per sample site).

SI = 0.1 if logs, brush piles, matted vegetation, and/or rocks are absent From sample area.

<u>HSI Determination</u>

For annual grasslands and seasonal wetlands.

$$HSI = \frac{V_1 + V_2 + V_3}{3}$$

For oak woodlands and riparian woodlands:

$$HSI = \frac{V_1 + V_2 + V_3 + V_4}{4}$$

All variables are assumed to contribute equally to the availability of a given habitat type for the California vole. Water is assumed not be a limiting factor and is represented by the herbaceous vegetation variables.

Model Applicability

This model is a hypothesis of the relationships between various attributes of grassland, wetland, and oak riparian woodland habitats and the suitability of these habitats to California voles. The model is designed for use in the Central Valley of California up to 2,500 feet in elevation. California voles are permanent yearround residents, and this model can be applied to these habitats at all times of the year.

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HABITAT SUITABILITY INDEX MODEL
Plain Titmouse (*Parus inornatus*)

by
Michael Long and Daniel Strait
U.S. Fish and Wildlife Service
Division of Ecological Services
Sacramento, California

June 1989

Habitat Use Information

General
The plain titmouse inhabits oak and piñon-juniper woodlands from Oregon south and west to Texas. It is a year-round resident, and maintains a territory throughout theyear. The species is generally a secondary cavity nester, although it may occasionally excavate its own hole.

Food
As a group, titmice take a wide variety of foods, but they are considered insectivorous during the summer, and consumers of fruit, seeds, and some insects in the winter (Ferrins 1979). Root (1967 - cited by Verner 1979), found that a large proportion of their food consisted of plant material and arthropods living on the bark of trees. Wagner (1981) found the plain titmouse took a great variety of arthropod taxa.

The titmouse is primarily a bark forager, although it also forages on tree foliage and occasionally on the ground (Hertz et. al. 1976). Most foraging by this species is done between 0-30 feet (0-9 m) of the ground (Wagner 1981; Hertz et. al. 1976). Hertz et al. found that plain titmice showed a preference for foraging in blue oaks (*Quercus douglasii*) over coast live oaks (*Q. agrifolia*). Hertz et. al. (1976) attributed the avoidance of live oaks to their smooth bark which is poor habitat for arthropods. Block and Morrison (1986) also found the titmouse to use blue oaks more than valley oaks (*Q. lobata*), black oak (*Q. kelloggii*), and canyon live oak (*Q. chrysolepis*) for foraging at Tejon Ranch, California. The plain titmouse will forage extensively in live oaks however, especially when other oak species are not present (Dixon 1964).

Reproduction
The plain titmouse is a secondary cavity nester, nesting in natural cavities, old woodpecker holes, or nest boxes. It prefers natural cavities over excavated cavities (Wilson, pers. comm.). Bent (1946) reported nests from 3-32 feet (1-10 m) above the ground. Bent, citing Dawson (1923), reported the titmouse to occasionally excavate its own nest cavity in blue oaks. The plain titmouse prefers wooded areas with intermediate to high percentage canopy coverage dominated by blue, live and valley oaks (Verner and Boss 1980).

Cover
Cover is provided by the oak woodlands and riparian areas in which the plain titmouse lives. Roost sites are provided by natural cavities, old woodpecker holes, or by dense foliage which simulates a cavity (Dixon 1949).

Interspersion
Plain titmice maintain year-round territories. Three territories observed by Hertz et. al. (1976) averaged 2.0 acres (0.8 ha) in California oak woodland. Dixon (1949) found 12 territories ranged located primarily in live oak woodland. These territories ranged in size from 3.3-12.5 acres (1.3-5.1 ha) with an average size of 6.3 acres (2.6 ha). According to Dixon (1956) 2.5 acres (1.0 ha) would probably be close to an absolute minimum size for a territory.

Water Requirements
In a study by Williams and Koenig (1980), the plain titmouse was classified as an occasional drinker.

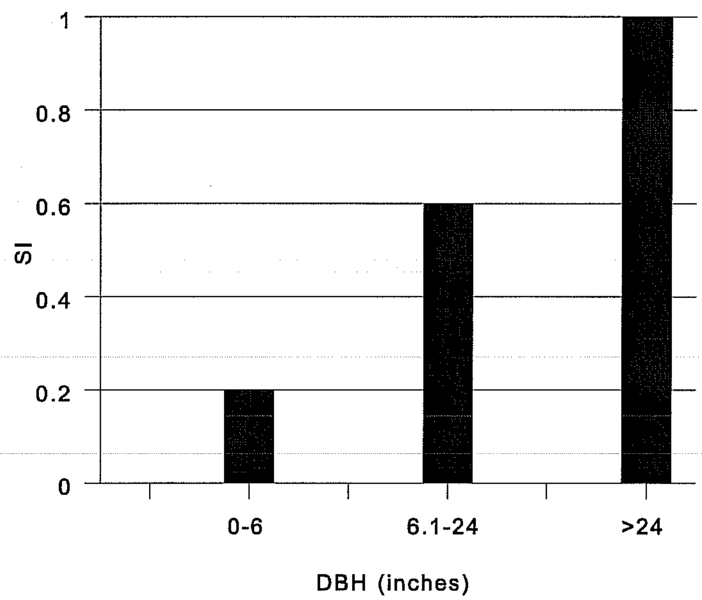
Model Applicability
This model was developed for use in evaluating habitat suitability of oak savannah, oak woodland, and riparian woodland in Merced, Fresno, Stanislaus, and San Benito Counties in California from 500- 2,500 ft in elevation. The basic assumptions for using the model are that meeting the reproductive needs of the plain titmouse will take care of its cover and food needs throughout the year. This assumption seems warranted. Verner (1979) believes that proper management for oaks for breeding birds should also provide the habitat needs for speciesthat use oaks at other times of the year. In addition, it is assumed that water is not a limiting factor. It is assumed that the model is valid for use in riparian areas as well as the oak woodlands despite the fact that the model was initially developed for oak woodlands.

Model Description

Little quantitative data were found on the habitat needs of the plain titmouse. The most useful information was the information on habitat factors related to breeding for the species presented by Ohmann and Mayer (1986). Using data from the California Wildlife Habitat Relationships data base and the Forest Inventory and Analysis Research Unit inventory, Ohmann and Mayer developed a habitat suitability index model for the plain titmouse from which Variable 1 was derived.

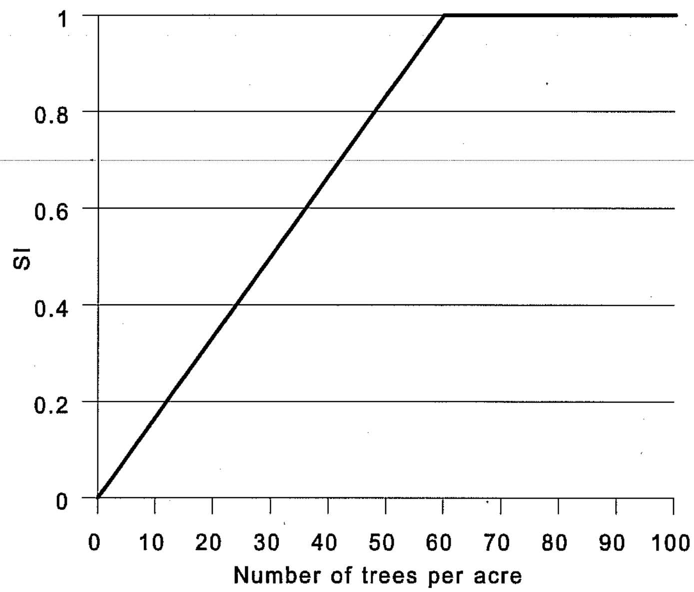
Variable 1. Tree diameter. (A tree is defined as a woody plant species 16 feet high or greater)

Ohmann and Mayer found tree size and percent canopy closure to be the major variables determining suitability of a habitat for the plain titmouse. Our model will assume that the diameter of a tree and the size of the canopy are correlated to the extent that they can be considered a single variable to be represented in this model by diameter at breast height (DBH). Presumably this variable best represents older trees with more cavities for nesting and greater bark surface which supports a greater prey base.



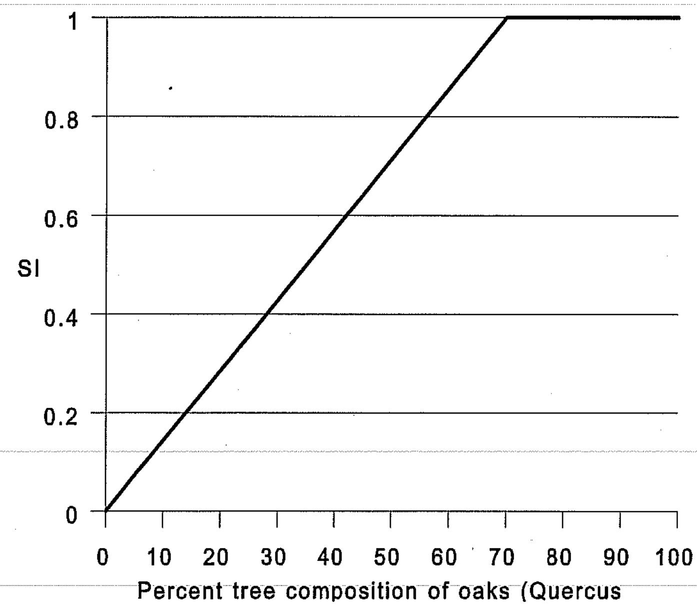
Variable 2. Trees per acre.

Plain titmouse abundance was found to increase as the number of trees increased (Wilson, pers. comm.). This may be particularly important in areas of low to moderate canopy cover. Studies at the Hopland, California field station found titmouse abundances to peak in areas with 60 trees/acre.



Both Variables 1 and 2 relate directly to the extent of a stand's canopy closure such that the importance placed on canopy closure by Ohmann and Mayer is incorporated into this model through the use ofVariables 1 and 2.

Variable 3. Percent composition of tree species that are oaks (*Quercus*).
Verner and Boss (1980) stated that the plain titmouse prefers stands dominated by blue, live and valley oaks. We have been unable to find and studies documenting the presence of the plain titmouse in an area without a major proportion of oaks. For the sake of this model then, we will consider the presence of oaks to be a life requisite such that the optimum titmouse habitat is one dominated by oaks.



HSI Determination

In each sample area, tree diameter is measured along with the number of trees per acre and the percentage of those trees that are oaks. The Habitat Suitability Index for the sample site is then determined using the following formula:

$$HSI = \frac{V1 + V2 + V3}{3}$$

Suggestions for Applying the Model

1. The tree diameter classes for calculating Variable 1 (DBH) were not specified by Ohmann and Mayer. Therefore, all trees within the sample plot should be included in the DBH determination.

2. If no trees, 4-inch DBH or greater, are found in the sample plot, the HSI for the sample plot is 0.0. A 4-inch DBH tree is probably about the smallest tree that could have a cavity of sufficient size for the titmouse.

3. Ideally, all tree species in the study area should be fully leafed out when applying the model. Therefore, the best time for sampling is spring and summer.

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BOBCAT

HABITAT SUITABILITY INDEX MODEL

HABITAT SUITABILITY INDEX MODEL

BOBCAT (*Felis rufus*)

Pacific Gas and Electric Company

1986

Geographic Area: This HSI Model was developed for use on the west slope of the Sierra Nevada in Fresno County, California.

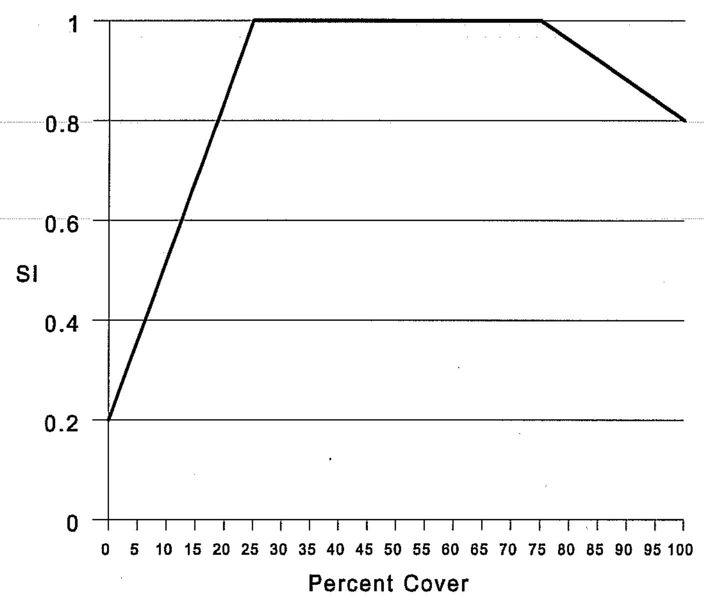
Season: This model was developed to evaluate year-round habitat suitability for the bobcat *(Felis rufus)*.

Cover Types: This model was designed to evaluate habitat suitability for the bobcat in the Chaparral cover type (terminology follows that of Verner and Boss 1980).

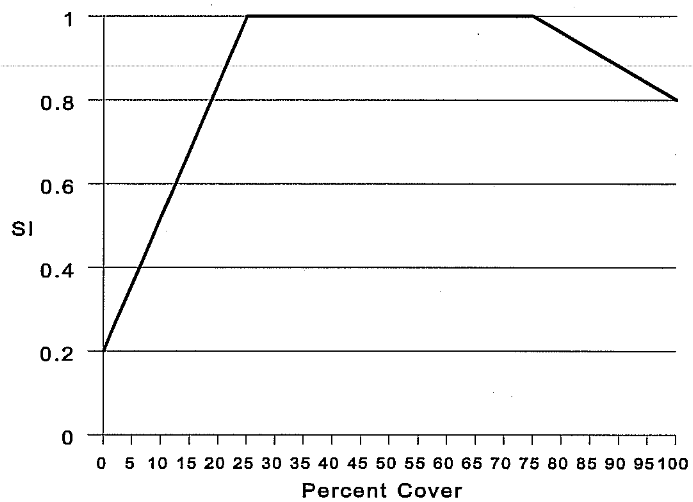
Guild:	Feeding	Breedinq
	Surface	Subsurface

Equation: $$HSI = \frac{(V_1 + V_2 + V_3 + V_4)}{5}$$

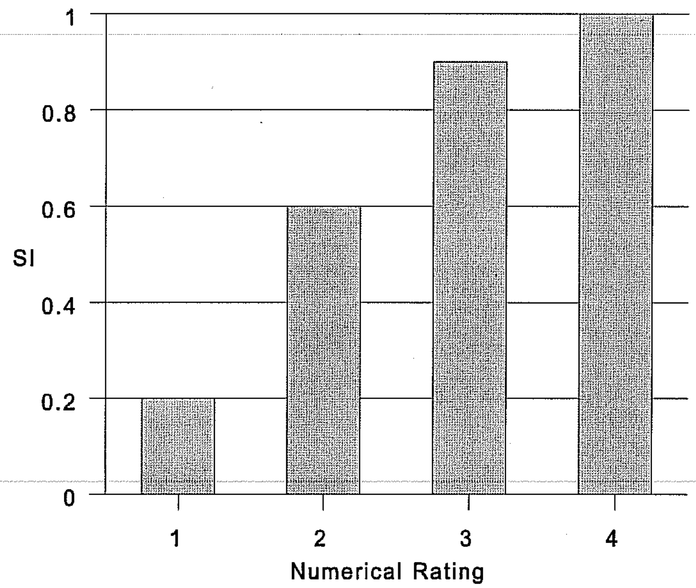
V1 - Percent Shrub Cover



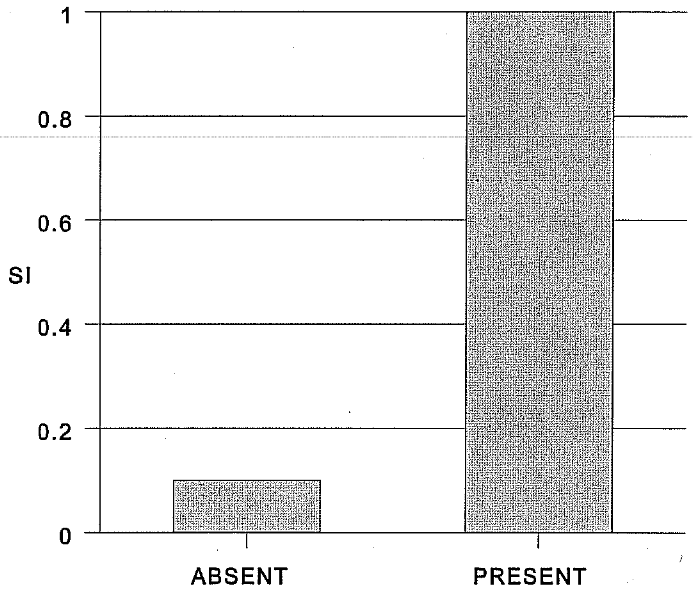
V2 - Herbaceous Cover



V3 - Degree of Patchiness



V4 - Rock Outcroppings



FISH AND WILDLIFE HABITAT CAPABILITY MODELS

AND

SPECIAL HABITAT CRITERIA

FOR THE NORTHEAST ZONE NATIONAL FORESTS

LASSEN NATIONAL FOREST
MENDOCINO NATIONAL FOREST
MODOC NATIONAL FOREST
PLUMAS NATIONAL FOREST

Karen Shimamoto and Daniel Airola (editors)

JANUARY 15, 1981

INTRODUCTION

by Hal Salwasser and Karen Shimamoto

Under National Forest Management Act (NFMA) planning regulations (36 CFR 219), fish and wildlife management indicator species are selected by each Forest for planning and management attention. These species will help guide land allocations and shape multiple-resource prescriptions in meeting legal requirements and local resource demand. To support this role each species must have a documented description of the habitat conditions needed to sustain it at different population levels. The minimum habitat conditions necessary for sustaining population viability are also required. The development of prescriptions to favor certain management indicator species also requires a description of habitat conditions associated with high population levels of each species. The descriptions of habitat conditions associated with different population levels are called Habitat Capability Models (HCM).

NFMA regulations mandate that each Forest maintain habitat conditions to support wildlife and fish populations at or above the abundance and distribution needed for long-term population viability. However, neither managers nor scientists fully know what kinds, amounts, and distribution of habitats are necessary to maintain population viability. Therefore, existing knowledge of species ecology and habitat needs must serve to describe the habitat conditions needed. Models (standards and criteria) must be formulated to describe in quantitative and qualitative terms the habitat conditions by which to judge existing and projected habitat resources.

Most of the HCMs address the habitat conditions required by individual reproductive units within wildlife and fish populations. This is because land management projects usually affect small part of populations such as a breeding pair, a family unit, a small group of breeding pairs, or a small group of family units before whole population changes are noticed. Total population abundance and distribution on the Forest can be projected by aggregating and mapping those land areas that provide capable, available, and suitable habitat for reproductive units of populations.

The HCMs do not address some aspects of population viability. Minimum to optimum distances between reproductive units and population size are two important attributes of viability that must be addressed for relevant species outside the HCMs.

Special Habitat Criteria were first developed by biologists on the Stanislaus National Forest as an extension of the HCM concept (Hurley et al 1981). While HCMs describe habitat conditions for individual management indicator species, the information in the Special Habitat Criteria models describes conditions necessary to maintain or optimize populations of fish and wildlife species closely associated with special habitats (riparian, aspen, snags, etc.).

HABITAT CAPABILITY MODELS

The following format was used in the construction of each habitat capability model.

Model Applicability

Life Stage(s) - Identify the appropriate life stages covered by the model e.g. egg, larval, fry, juvenile, adult, all

Season(s) - Identify the appropriate season(s) e.g. fall, winter, spring, summer

Geographic Area - The model may apply to the species' entire range. However, if regional differences in habitat use and preference occur, separate models may be appropriate.

Intended Application - Most models will be formulated with Forest planning in mind. Some models, however, may be detailed enough to apply to project work. Provide a clear statement of the intended use.

Expected Reliability - The following hierarchy was used:

Level 1 - Model predicts existing carrying capacity density with acceptable variance, i.e. 10-20%

Level 2 - Model habitat capability ratings directly correlate with density estimates

Level 3 - Model habitat capability ratings directly correlate with ratings of the same sites by species authorities

Level 4 - Model structure and outputs appear reasonable to species authorities

Level 5 - Model structure and outputs meet technical standards and appear reasonable to author(s), editor(s), and users.

Verification Status - The purpose of verification is to ensure that the model meets the expected reliability criteria and that it faithfully provides the intended outputs. Each step in verification depends on the expected reliability of the model. The following hierarchy was used:

1) Model is in draft.

2) Model reviewed by editor (the editor should check for conformance with model quality standards, sufficiency of documentation, and understandability).

3) Model reviewed by editor and users.

4) Model reviewed by species authority.

5) Model evaluated with sample data - apply the model with sample data sets which mimic various habitat conditions, e.g. high, medium, and low habitat capability. Evaluate model outputs as to how well they give a reasonable prediction of habitat conditions.

6) Model tested with field data - field data must be available to provide measurements of both habitat variables and indicators of habitat capability. The latter can range from ratings of habitat capability by species authorities to density estimates to actual densities. Statistical and sampling expertise is required to design and perform these tests.

Model variables were restricted to physical, chemical, or biological characteristics of habitats. Species population variables, such as birth rates and sex ratios, are not suitable due to high cost of measurement, difficulty of prediction, and dependency on other factors beyond habitat. The critical question answered was, "what environmental variable, when changed, will affect the capability of an area to support a management indicator species?"

Each of the identified habitat variables were combined with the others to produce a habitat capability model. Each variable has values with different implications for habitat capability. For example, the variable average tree canopy cover has a high habitat value for goshawks when it is between 40-60%. Each of the variables and its respective values were ranked according to habitat capability:

High: the values are related to the highest densities of the species; the values are preferred over other values;

Medium: the values are related to moderate densities of the species; the values are required for the long-term viability of the population or reproductive unit of the population:

Low: the values are related to the lowest densities of the species; the values are denote marginal habitat capability for the species and would not be capable of supporting a viable population.

The variables were organized according to their importance in determining habitat capability and arrayed in rows under the headings high, medium, and low. An attempt was made to reduce redundant variables, retaining only those variables that are most practical to measure.

Documentation

As in model reliability and verification status, documentation for each model is in varying stages of completion. The levels of documentation are:

Level 1 - Literature references, written or personal communication, and the author's judgement are cited.

Level 2 - A narrative accompanies the model, summarizing why each variable was selected, how each variable is related to the species' habitat needs, and how habitat capability values were determined. This level also includes Level 1.

Level 3 - A narrative accompanies the model with documentation on the species ecology and habitat use. This information is related to the habitat variables in the model. It involves preparing a species note with the following information:

I. Distribution, Abundance, and Seasonality

II. Specific Habitat Requirements

A. Feeding
B. Cover
C. Water
D. Reproduction
E. Pattern

III. Species Life History

A. Activity Patterns
B. Seasonal Movements/Migration
C. Home Range/Territory
D. Reproduction
E. Niche

This level also includes Levels 1 and 2.

Level 4 - The habitat variables are aggregated to develop a mathematical formulation of the model (U.S. Fish and Wildlife Service 1980). Assumptions and limitations to be used when applying the model are provided and the necessary steps to correctly use the mathematical model is documented. The latter includes how to collect data on model variables, how to treat that data as model inputs, and how to interpret habitat capability based on the data. This level includes levels 1, 2, and 3.

Because many initial species models will be developed from scant data, modelers will rely on experiential evidence and intuition to establish the model variables and relationships. Such models will have level 1 or 2 documentation. As model application and verification improve, habitat relationships can be more accurately represented and the models made more quantitative. Models with level 3 or 4 documentation are examples of species where more information is known and the models have been "calibrated" with real data.

Vegetation Types and Successional Stages

The vegetation types and successional stages used in the habitat capability models are consistent with the California Wildlife Habitat Relationships Program for the Northeast Interior Zone (Laudenslayer in prep), the Western Sierra Zone (Verner and Boss 1980) and the North Coast-Cascades Zone (Marcot 1979). For convenience, the codes used for successional stages are defined in Table 1.

Rating Overall Habitat Capability

For any given area of land, habitat capability ratings (high, medium, low) will be different for each habitat variable. This makes rating the overall habitat capability difficult. Models for spotted owl and mule deer, have been developed to include a mathematical calculation of habitat capability where different ratings are quantitatively assessed and an overall capability index is mathematically calculated. The method for rating overall habitat capability for the other models, however, must be done using subjective biological judgement.

For such cases, the simplest approach is to assess the overall habitat capability rating in terms of a simple majority of variable ratings. For example, if three variables were rated as medium and one variable as high for bald eagle habitat, the overall rating could be considered medium.

In other situations, experience may justify identifying one or more variables as more important or possibly overriding other variables. Biologists should then weight these variables accordingly when determining overall habitat capability.

Table 1. Successional stage codes

Code	Definition
1	Barren/grass/forbs
2	Shrub/seedling/sapling; tree saplings <11" DBH
2a	<40% tree canopy closure
2b	40-70% tree canopy closure
2c	>70% tree canopy closure
3	Small sawtimber; 11-24" DBH
3a	<40% overstory canopy closure
3b	40-70% overstory canopy closure
3c	>70% overstory canopy closure
4	Medium to large sawtimber; >24" DBH
4a	<40% overstory canopy closure
4b	40-70% overstory canopy closure
4c	>70% overstory canopy closure
5	Two-storied stand; scattered overstory over a well-stocked understory (4a over 2c or 3c)

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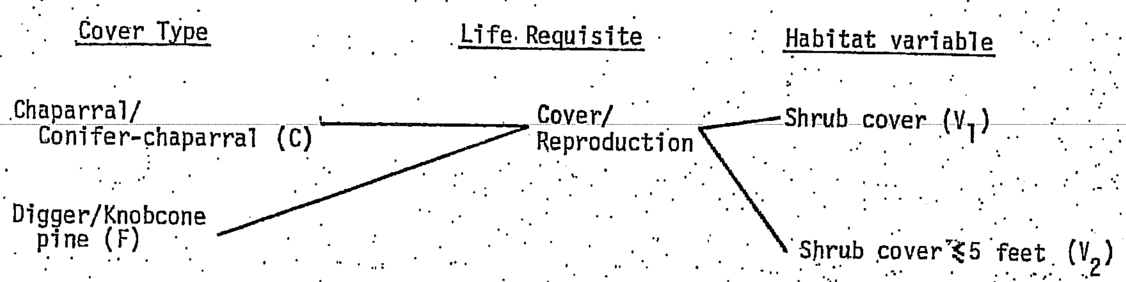
DRAFT
HABITAT SUITABILITY INDEX MODEL
WRENTIT (Chamaea fasciata)

U.S. Fish and Wildlife Service
Division of Ecological Services
Sacramento, California

September 1984

VARIABLE		COVER TYPES	SUGGESTED TECHNIQUE
(V_1)	Shrub cover - % of ground shaded by a vertical projection of the shrub canopy	C,F	Line intercept
(V_2)	Shrub cover ≤5 feet	C,F	Belt transect, graduated rod

2

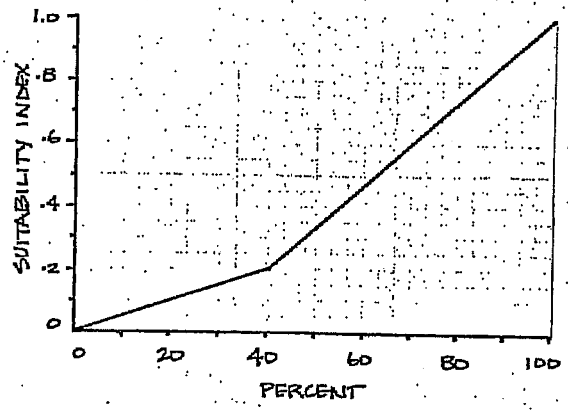

Cover Type
Life Requisite
Habitat variable
Chaparral/ Conifer-chaparral (C)
Digger/Knobcone pine (F)
Cover/ Reproduction
Shrub cover (V_1)
Shrub cover ≤5 feet (V_2)

Variable 1. Shrub cover - % of ground shaded by a vertical projection of the shrub canopy

Assumes: 1) Dense stands of chaparral needed for optimum conditions.

2) Sample size should include an area of at least 2.0 acres

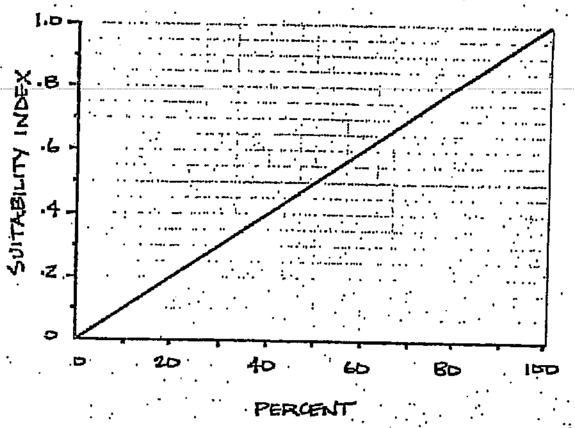
3) 40 percent canopy provides marginal quality and that 100 percent is optimum



Variable 2. Shrub cover ≤5 feet

Assumes: 1) Most nests are located within 1-4 feet from the ground.

2) Some additional height is needed for overhead protection.



4

Equation Used to Calculate Suitability Indices

Cover/Reproduction: $V_1 \times V_2$

HSI determination

Cover/reproduction was the only life requisite considered in this model, and the HSI for the wrentit is equal to the life requisite value for cover/reproduction.

General Assumptions

Overview

This model uses the reproductive habitat needs of the wrentit to determine overall habitat quality. It is assumed that cover needs are met by reproductive habitat needs and that neither food nor water will be more limiting than the wrentit's cover/reproductive needs. All of the life requirements of the wrentit can be provided in chaparral and other dense brush.

Cover/ reproduction component

Optimal nesting habitat for the wrentit is provided in moderately tall, dense stand of chaparral (Bent 1968, Small 1974). Dense stands of chaparral provides maximum protection for feeding and nesting. As such, it is assumed that optimal habitat contains 100 percent or greater of shrub crown canopy. Studies indicate that most of the nesting occurs between 1 and 4 feet off the ground and only occasionally have nests been found up to 7 feet from the ground (Bent 1968). Most of the wrentit's existence is spent beneath the crown foliage of brush not more than 5 feet from the ground (Bent 1968). Studies indicate that most of the life requisites of the wrentit are provided within an area ranging in size from 0.2 to 1.2 ha (0.5 to 3.0 acres) (Cogswell 1962, Bent 1968, Erickson 1938).

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Harrison, H.H. 1979. A field guide to western birds nests, Houghton Mifflin Co. Boston.

Small, A. 1974. The Birds of California. Collier Macmillan Pub. Co., New York

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Shasta C

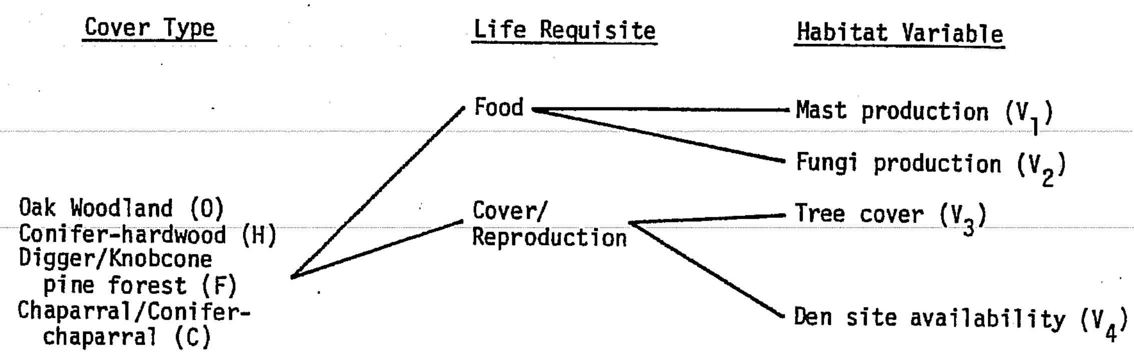
DRAFT HABITAT SUITABILITY INDEX MODEL
WESTERN GRAY SQUIRREL (<u>Sciurus griseus</u>)

U.S. Fish and Wildlife Service
Division of Ecological Services
Sacramento, CA

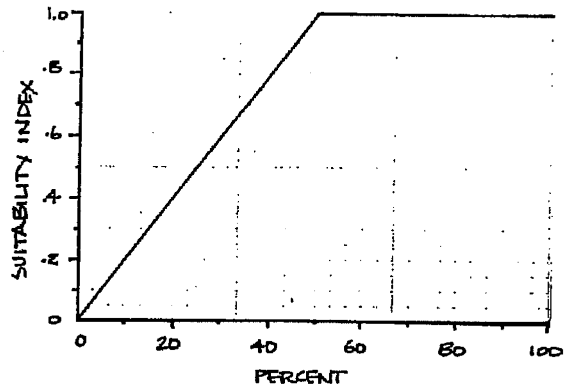
September 1984

squirrel

VARIABLE	COVER TYPES	SUGGESTED TECHNIQUE
(V_1) Mast production - % canopy closure of trees > 5 m (16.5 ft) tall and shrubs that produce hard mast	O,H,F,C	Line intercept
(V_2) Fungi production - estimate of density of leaf litter layer	O,H,F,C	Ocular estimate along line intercept
(V_3) Tree cover - % of ground surface shaded canopies of all woody vegetation > 5 m (16.5 ft) in height	O,H,F,C	Line intercept
(V_4) Den site availability - number of trees per acre with dbh ≥ 38.1 cm (15 in).	O,H,F,C	Belt transect, diameter tape



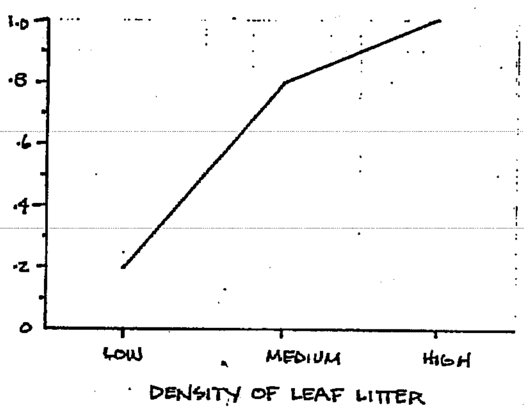
Variable 1. Hard mast production - % canopy closure of trees ≥ 5 m (16.5 ft) tall and shrubs that produce hard mast (e.g. oaks and conifers).



Assumes: 1) Optimum density of hard mast trees is between 40 - 100% canopy closure (derived from Shimamoto and Airola, 1981).

2) Trees ≤ 5 m (16.5 ft) tall will not produce significant mast (Allen, 1982).

Variable 2. Fungi production - an estimate of the density of the leaf litter layer.



Assumes: 1) Hypogeous fungi is a major component of the western gray squirrel diet (Stienecker, 1977).

2) Fungi is related to the amount of organic material (represented by leaf litter) in the uppermost soil layers (SCS, 1980).

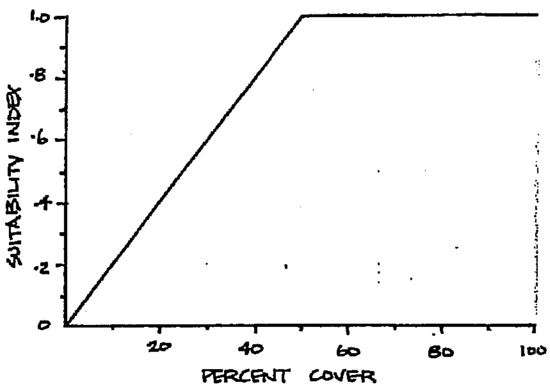
Density of Leaf Litter (from SCS, 1980):

High - leaf litter is abundant with thick identifiable layers of leaves over mulch.

Medium - leaf litter is moderately abundant with low to moderate separation of leaf-mulch layers.

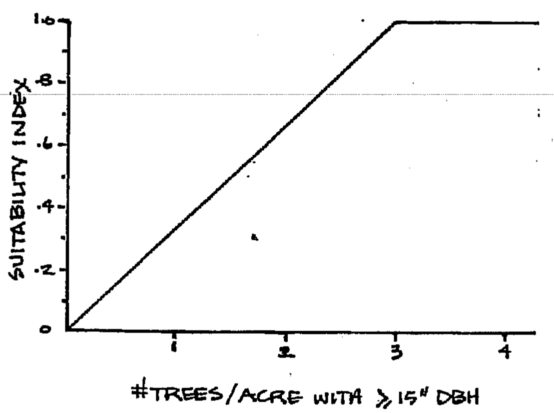
Low - leaf litter scarce with very thin leaf - mulch layer; little or no separation.

Variable 3. Tree cover - % of ground surface shaded by vertical projection of canopies of all woody vegetation ≥ 5 m (16 ft.) tall



Assumes: 1) Optimum conditions occur when tree cover ranges from 40 to 100% (derived from Shimamoto and Airola, 1981).

Variable 4. Den site availability - number of trees per acre with dbh ≥ 38.1 cm (15 in)



Assumes: 1) Western gray squirrels most often utilize oak, cottonwoods, maples, conifers, and sycamores for den sites (Ingles, 1947).

2) Optimum den sites are provided by trees having an average dbh of 15 inches (Shimamoto and Airola, 1981).

5

Equations Used to Calculate Suitability Indices

a) Food:

Cover Type	Equation
O,H,F,C	$(V_1 \times V_2)^{1/2}$

b) Cover/Reproduction:

Cover Type	Equation
O,H,F,C	$(V_3 \times V_4)^{1/2}$

HSI Determination:

1) The minimum habitat area equals the mean minimum home range. If habitat area is less than one acre, the HSI value equals zero. (Ingles, 1947).

2) The HSI for the western gray squirrel will equal the lowest of the values for the food and cover/reproduction component.

Literature Cited

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APPENDIX B

AMERICAN RIVER WATERSHED INVESTIGATION
FOLSOM DAM BRIDGE PROJECT, CALIFORNIA

ENDANGERED SPECIES CONSULTATION

MAY 2005

United States Department of the Interior

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

In reply refer to:
1-1-05-F-0108

MAY 4 2005

Mark C. Charlton
Chief, Planning Division
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Subject: Endangered Species Section 7 Consultation for the U.S. Army Corps of Engineers' *Proposed Material Borings for the Folsom Bridge Project*, Sacramento County, California

Dear Mr. Charlton:

This letter is in response to your April 11, 2005, letter requesting formal consultation with the U.S. Fish and Wildlife Service (Service) on the U.S. Army Corps of Engineers' (COE) proposed material borings (proposed project) to determine the material conditions and engineering properties associated with the bridge construction. This is considered the initial phase of the larger Folsom Bridge project within Sacramento County, California. Your letter was received in this office on April 14, 2005. Elderberry shrubs are the sole host plant for the valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (beetle). In accordance with section 7 of the Endangered Species Act of 1973, as amended (Act), this document represents the Service's biological opinion of the effects of the proposed action on the threatened beetle.

Our analysis of potential effects to the valley elderberry longhorn beetle is based on the following information: (1) the COEs' April 11, 2005 letter describing the proposed project; (2) several site visits and meeting that occurred between March 7 and April 14, 2005 with COE and Service biologists; (3) the Services informal consultation (Service Ref. No.1-1-05-I-0565) on the proposed soil borings for the same project; (4) the Service's 1999 *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* (Guidelines); and (5) other information available to the Service.

TAKE PRIDE IN AMERICA

Consultation History

January 31, 2005. Consultation for the Proposed Soil Borings and Auger Borings Associated with the Folsom Dam Bridge Bypass, Sacramento County, California. (Service Ref. No. 1-1-05-I-0565)

February 22, 2005. Service and COE staff conducted a site visit to proposed boring locations and access roads.

March 7, 2005. Biologists from the COE, Jane Rinck and Becky Victorine and the Service Doug Weinrich and Stephanie Rickabaugh, conducted Habitat Evaluation Procedures (HEP) and surveyed elderberry shrubs at the proposed project site.

March 24, 2005. The Service received a letter from the COE requesting formal Section 7 consultation on the proposed material borings for the *Folsom Bridge project, Sacramento, California*. The letter was received by the Service on March 24, 2005.

March 25, 2005. Jane Rinck, telephoned Doug Weinrich and stated that changes were being made to the project description outlined in the March 24, 2005 consultation letter. During that telephone call, it was agreed the COE would send a new letter initiating Section 7 consultation with the new project description.

April 14, 2005. Service and COE staff confirmed a minor change in a boring location would not have direct impacts on elderberry shrubs.

April 14, 2005. The Service received a letter from the COE requesting formal Section 7 consultation on the proposed material borings for the *Folsom Bridge Project, Sacramento, California*. The letter was dated April 11, 2005.

April 27, 2005. The Service received an electronic letter from the COE clarifying the compensation for the proposed *Material Boring project* and their request to defer some of the compensation to be included in the proposed *Folsom Bridge project*. A follow up telephone conversation between Jane Rinck, COE and Stephanie Rickabaugh, FWS further clarified the compensation numbers stated in the electronic letter.

BIOLOGICAL OPINION

Description of the Proposed Action

In 1992 a temporary bridge across the American River was authorized, as part of the American River Watershed Project. The temporary bridge was analyzed in the *Long Term Study Final Supplemental Plan Formulation Report/ Environmental Impact Statement (EIS)/Environmental Impact Report (EIR)*. However, the COE, Sacramento District, has recently been authorized by Congress to construct a permanent bridge that spans the American River below Folsom Dam.

A draft EIS/EIR, containing a full description and analysis of the permanent bridge project alternatives is expected to be completed by August 2005.

As part of the initial phase of the permanent bridge project, the COE is requesting consultation on the material borings to determine the material conditions and engineering properties for use in the subsequent bridge construction. The boring work is scheduled to begin April 18, 2005, and would be completed by the end of June 2005.

The material borings would include 16 core boring and 20 auger borings. Borings would be done on the west and east sides of the American River just below the Folsom Dam spilling basin. The core borings would be about 75 feet deep and take about three days per hole to complete. Core borings No. 1 through No. 8 would be done with equipment mounted on a truck; borings No. 9 and No. 10 would likely be done with equipment brought in with a helicopter or a skid rig. The auger borings would be about 20 feet deep, and about three holes would be completed in one day. The auger borings would be done with either truck- or track-mounted equipment. One to two additional vehicles would accompany the boring equipment.

Access to the boring sites on the north side of the river would be via existing dirt and paved roads and trails. The equipment for two of the core borings, No. 7 and No. 8, would be brought in by helicopter. On the south side of the river, some new access roads would be needed. For core borings No. 11 and No. 12, a temporary trail would be cut through an areas of annual grassland, thus no woody vegetation would be affected.

Access to core borings No. 9 and No. 10 would require construction of a new road. The new road would be about 500 feet in length; start and connect with an existing dirt road on Folsom Prison property. The road would be constructed using a Cat D-6 dozer or similar sized equipment. Some cut and fill would be required for the road construction but it will follow an existing terrace. The road would be a level width of 8 feet. Efforts would be made to keep the disturbance of the surrounding area to a minimum.

On the south side of the river, there are 14 elderberry shrubs within 100 feet of the new access road that would be constructed to access borings No. 9 and No. 10. These shrubs would be indirectly affected by the boring road construction; however, two of these shrubs (P22 and P23) would be directly affected by the construction of the proposed bridge project.

On the north side of the river, there is one elderberry shrub (#302) within 100 feet of the proposed boring work. This shrub would be within 75 feet of core boring activities. This shrub has a total of 13 stems over 1 inch in diameter with no exit holes. All of the equipment and activities would remain 75 feet from the shrub. However, this shrub would be directly affected by the proposed bridge project, and field surveys have determined that this shrub could not be transplanted because of the severe slope and/or large shrub size.

All 15 shrubs are in non-riparian habitat based on their location. They are high up on steep, north facing, rocky slopes where water drainage from above and is kept to the surface by the rocks; at no point would these shrubs be inundated by floodwaters along the American River.

The river does not appear to be influencing the shrubs found along this section of hillside. No exit holes were found on any of these shrubs.

The COE proposes to compensate for adverse affects from the proposed material borings project at a rate 3.5x the normal compensation because the work is being done during the beetle's flight period when the beetles are vulnerable to dust and disturbance. However, the COE requests that the compensation for the three shrubs directly affected by the proposed bridge project be included in the subsequent bridge consultation. This subsequent compensation for the three shrubs has been agreed to by the Service.

Proposed Minimization Measures

For Direct and Indirect Effects:

1. Complete avoidance (*i.e.*, no adverse effects) will be achieved whenever possible, using a 100-foot (or wider) buffer established and maintained around elderberry plants containing stems measuring 1.0 inch or greater in diameter at ground level. Firebreaks may not be included in the buffer zone. In buffer areas, construction-related disturbance will be minimized, and any damaged area will be promptly restored following construction. The Service will be consulted before any additional disturbances within the buffer area are undertaken. In addition, the Service will be provided with a map identifying the avoidance area and written details describing avoidance measures.

2. All elderberry areas to be avoided during construction activities will be fenced and flagged. In areas where encroachment into the 100-foot buffer has been approved by the Service, a minimum buffer setback of at least 20 feet will be provided from the dripline of each elderberry plant.

3. Work crews and contractors will be given environmental awareness training that will emphasize the identification of elderberry shrubs and the need to avoid damaging the elderberry shrubs and the possible penalties of non-compliance.

4. Water trucks and/ or hoses with portable pumps will be used to control fugitive dust during road construction.

5. Signs will be erected every 50 feet along the edge of the avoidance area with the following information: "This area is habitat of the valley elderberry longhorn beetle, a threatened species, and must not be disturbed. This species is protected by the Endangered Species Act of 1973, as amended. Violators are subject to prosecution, fines, and imprisonment." The signs should be clearly readable from a distance of 20 feet and will be maintained throughout the construction period.

Restoration and Maintenance Measures

1. Any adverse effects to the buffer area (within 100 feet of elderberry shrubs) during construction will be restored. Erosion control and revegetation with appropriate native plants will be provided for the affected areas.

2. After construction, if appropriate, buffer areas will continue to be protected from the adverse effects of the project. Appropriate measures will include fencing, weeding, posting signs, and removing trash.

3. Associated native plants will be planted in the same area as elderberry seedlings.

4. No insecticide, herbicides, fertilizers, or other chemicals that might harm the elderberry shrub or the beetle will be used within 20 feet of any elderberry shrub with one or more stems measuring 1.0 inch or greater in diameter at ground level.

5. A written description of the restoration, protection, and maintenance of the adversely affected areas will be provided to the Service within 30 days of construction completion.

Elderberry plants for which impacts cannot be avoided shall be compensated for, at a rate 3.5x the normal rate and following the criteria set forth in Table 1 of the Guidelines, as modified by the Service. These guidelines provide for transplanting and planting of elderberries, as well as planting of associated riparian vegetation.

Status of the Species/Environmental Baselines

Valley Elderberry Longhorn Beetle

The beetle was federally listed as a threatened species on August 8, 1980 (45 FR 52803). Critical habitat for the species was designated for this animal. Two areas along the lower American River in the Sacramento metropolitan area have been designated as critical habitat for the beetle–one along the American River at Goethe and Ancil Hoffman parks (American River Parkway Zone) about 10 miles upstream from the river's mouth and another at the Sacramento Zone, an area about 2 miles upstream from the river's mouth and about 0.5-mile northeast of the river's right-bank (downstream aspect) levee. In addition, an area along Putah Creek in Solano County and an area west of Nimbus Dam along the American River Parkway, Sacramento County, are designated as essential habitat in the *Valley Elderberry Longhorn Beetle Recovery Plan* (Service 1984). Each of these areas is known to support large numbers of mature elderberry shrubs with evidence of beetle use.

The beetle depends on its host plant, the elderberry shrub. Elderberries are locally common components of the remaining riparian forest and savannah landscapes, and to a lesser extent the mixed chaparral-foothill woodlands, of the Central Valley. Use of elderberry shrubs plants by the beetle, a wood borer, is rarely apparent. Frequently, the only exterior evidence of the shrub's use by the beetle is an exit hole created by the larva emerging just prior to the pupal stage.

Observations of elderberry shrubs along the Cosumnes River and in the Folsom Lake area indicate that larval beetles can be found in elderberry stems with no apparent exit holes; the larvae either succumb prior to constructing an exit hole or not developed sufficiently to construct one. Larvae appear to be distributed in stems which are 1.0 inch or greater in diameter at ground level and can occur within both living and dead stems. The *Valley Elderberry Longhorn Beetle Recovery Plan* (Service 1984) and Barr (1991) further describe the beetle's life history.

Beetle densities are probably naturally low (Service 1984); and it has been suggested, based on the spatial distribution of occupied shrubs (Barr 1991), that the beetle is a poor disperser. Low density and limited dispersal capability result in high vulnerability to the negative effects of habitat fragmentation and the resulting isolation of small sub-populations.

When the beetle was initially listed as threatened, the species was known from less than 10 localities along the American and Merced Rivers, and Putah Creek. By completion of the *Valley Elderberry Longhorn Beetle Recovery Plan* in 1984, additional species localities had been found along the American River and Putah Creek. And by 1998, the California Natural Diversity Database (CNDDB) had catalogued 181 occurrences for this species in 44 drainages throughout the Central Valley; these occurrences ranged from the Sacramento River in Shasta County southward to an area along Caliente Creek in Kern County (CNDDB 1998). Additional CNDDB occurrences have been recorded between 1998 and 2003. Although the beetle continues to be threatened by long-term habitat loss and fragmentation due to extensive urbanization and land-use conversions throughout its range, relatively new threats included destruction by non-native Argentine ants (*Linepithema humile*), mortality due to pesticide drift, competition due to exotic plant invasions and the various adverse effects arising from livestock grazing.

Habitat loss has been ranked as the single greatest threat to biodiversity in the United States (Wilcove *et al.* 1998). In the 1980 final rule to list the beetle as threatened, habitat destruction was cited as the primary factor contributing to the need to federally list the species. As described in the final rule, by the time the species was listed, its habitat had largely disappeared throughout much of its former range, due to such factors as agricultural conversions, levee construction and stream channelization. The 1984 recovery plan reiterated the primary threats to the beetle as: loss and alteration of habitat by agricultural conversions; grazing; levee construction; stream and river channelization; removal of riparian vegetation; riprapping of shorelines; and recreational, industrial and urban development (Service 1984).

Riparian forests, the primary habitat for the beetle, have been severely depleted throughout the Central Valley over the last 2 centuries as a result of expansive agricultural and urban development (Katibah 1984; Thompson 1961; Roberts *et al.* 1977). Since human colonization, these forests have been "...modified with a rapidity and completeness matched in few parts of the United States" (Thompson 1961). As of 1849, the rivers and larger streams of the Central Valley were still largely undisturbed, supporting continuous bands of riparian woodland 4-5 miles in width along some major drainages such as the lower Sacramento River and generally about 2 miles wide along the lesser streams (Thompson 1961). Most of the riverine floodplains supported riparian vegetation to about the 100-year flood elevation level (Katibah 1984). A large human population influx after 1849, however, resulted in Central Valley riparian habitat being rapidly converted to agriculture and used as a source of wood for fuel and construction over a wide area (Thompson 1961). By 1868, riparian woodland had already been severely impacted in the Central Valley, as evidenced by the following excerpt:

> "This fine growth of timber which once graced our river (Sacramento), tempered the atmosphere, and gave protection to the adjoining plains from the sweeping winds, has entirely disappeared - the woodchopper's axe has stripped the river farms of nearly all the hard wood timber, and the owners are now obliged to rely upon the growth of willows for firewood." (Cronise 1868, *in* Thompson 1961).

The clearing of riparian forests for fuel and construction also made this land available for agriculture (Thompson 1977). Natural levees bordering the rivers, once supporting vast tracts of riparian habitat, became prime agricultural land (Thompson 1961, 1977). As agriculture expanded in the Central Valley, needs for increased water supply and flood protection spurred water development and reclamation projects. Artificial levees, river channelization, dam building, water diversion, and heavy groundwater pumping further reduced riparian habitat to small, isolated fragments (Katibah 1984). In recent decades, these riparian areas have continued in decline, as a result of ongoing agricultural conversion as well and urban development and stream channelization. As of 1989, there were over 100 dams within the Central Valley drainage basin and thousands of miles of water delivery canals and streambank flood control projects for irrigation, municipal and industrial water supplies; hydroelectic power; flood control; navigation; and recreation (Frayer *et al.* 1989). As a result, much of the riparian forests in the Central Valley have dwindled to discontinuous, unconnected narrow strips with widths measurable in feet compared to the former miles.

By some estimates, the Sacramento Valley once supported about 775,000-800,000 acres of riparian forest as recently as 1848 (Smith 1977; Katibah 1984). No comparable estimates are available for the San Joaquin Valley. Based on early soil maps, however, more than 921,000 acres of riparian habitat are estimated to have been present throughout the Central Valley under pre-settlement conditions (Katibah 1984). Another source estimates that of about 5.0 million acres of wetlands in the Central Valley in the 1850s, about 1.6 million acres were riparian wetlands (Warner 1985; Frayer *et al.* 1989).

Based on a California Department of Fish Game (CDFG) riparian vegetation distribution map, by 1979 there were about 102,000 acres of riparian vegetation remaining in the Central Valley. This represents a decline in acreage of about 89 percent as of 1979 (Katibah 1984). Significant losses were also estimated by Frayer *et al.* (1989), who reported that woody riparian forests in the Central Valley had declined to 34,600 acres by the mid-1980s (from 65,400 acres in 1939). These studies document the dramatic historic loss trend of riparian habitat in the Central Valley in general. And because the beetle's habitat is a key component of riparian habitat, it is a reasonable conclusion that loss of beetle habitat has been equally as dramatic.

A number of studies have focused on riparian loss along the Sacramento River, which supports some of the densest known populations of the beetle. About 98 percent of the middle Sacramento River's historic riparian vegetation is estimated to have been extirpated by 1977

(California Department of Water Resources 1979). It has been estimated that native riparian habitat along the Sacramento River from Redding to Colusa decreased from 27,720 acres to 18,360 acres (-34 percent) in just 2 decades from 1952 and 1972 (McGill 1975; Conrad *et al.* 1977). The average rate of riparian loss on the middle Sacramento River was 430 acres per year during this 2-decade period and 410 acres per year from 1972 to 1977. In 1987, riparian areas as large as 180 acres were observed to have been converted to orchards along this river reach (McCarten and Patterson 1987).

No comparable information exists on the historic loss of beetle habitat in non-riparian situations, such as elderberry savanna and other vegetation communities where elderberry occurs (*e.g.*, oak or mixed chaparral-woodland, or grasslands, adjacent to riparian habitat). However, all natural habitats throughout the Central Valley have been heavily impacted within the last 200 years (Thompson 1961) and we can therefore assume that non-riparian beetle habitat also has suffered a widespread decline. This analysis focuses on loss of riparian habitat, because the beetle is primarily dependent upon riparian habitat. Nevertheless, adjacent upland areas are also likely to be important for the species (Huxel pers com 2000), but this upland habitat typically consist of oak woodland or elderberry savanna bordering willow riparian habitat (Barr 1991). The riparian acreage figures given by Frayer *et al.* (1989) and Katibah (1984) included the oak woodlands concentrated along major drainages in the Central Valley and, therefore, probably included lands we would classify as upland habitat for the beetle adjacent to riparian drainages.

Between 1980 and 1995, human population growth in the Central Valley was about 50 percent, while the remainder of California grew by 37 percent. The Central Valley's population totaled 4.7 million by 1999, and it is expected to more than double again by 2040. The American Farmland Trust estimates that by 2040 more than 1 million cultivated acres will be lost and 2.5 million more put at risk (Ritter 2000) through urbanization related to population growth. The rapidly expanding human populations of the Central Valley will likely result in continued pressure on riparian habitat, related elderberry shrubs, and the beetle. As evidence, the Sacramento Office of the Service presently receives a number of requests each month for consultation on the beetle under section 7 of the Endangered Species Act.

While habitat loss is clearly a large factor leading to the species' decline, other factors may also pose significant long-term threats to the beetle's survival. Only about 20 percent of riparian sites with elderberries observed by Barr (1991) and Collinge *et al.* (in prep.) support beetle populations (Barr 1991; Collinge *et al.* in prep.). Jones and Stokes (1988) found that only 65 percent of 4,800 riparian acres on the Sacramento River had evidence of beetle presence. The fact that a large percentage of apparently suitable habitat is unoccupied suggests that the beetle is limited by other factors such as its limited dispersal ability, habitat quality, or habitat fragmentation.

Massive destruction of riparian habitat in central California has clearly resulted in not only a loss of acreage, but severe habitat fragmentation. Fahrig (1997) indicated that habitat fragmentation becomes most important for those habitats that have suffered greater than 80 percent loss. Riparian habitat in the Central Valley, which has experienced greater than 90 percent loss by most estimates, exceeds this criterion. Existing data suggests that beetle populations are affected by such habitat fragmentation. Barr (1991) found that small, isolated habitat remnants were less likely to be occupied by beetles than larger patches, indicating that beetle sub-populations are often extirpated from small remaining habitat fragments. Moreover, Barr (1991) and Collinge *et al.* (in prep.) consistently found beetle exit holes occurring in clumps of elderberry bushes rather than isolated bushes, suggesting that isolated shrubs are less viable host habitat for this species.

Habitat fragmentation such as now occurs can be an important factor contributing to a species' decline because: (1) it divides a large population into two or more small populations that become more vulnerable to direct loss, inbreeding depression, genetic drift, and other problems associated with small populations; (2) it limits a species' potential for dispersal and colonization; and (3) it makes habitat more vulnerable to outside influences by increasing the edge:interior ratio (Primack 1998).

Small, isolated sub-populations are susceptible to extirpation from random demographic, environmental or genetic events (Shaffer 1981, Lande 1988, Primack 1998). While a large area may support a single large population, the smaller sub-populations that result from habitat fragmentation may not be large enough to persist over the long-term. As a population becomes smaller, it tends to lose genetic variability through genetic drift, leading to inbreeding depression and a lack of adaptive flexibility. Smaller populations also become more vulnerable to random fluctuations in reproductive and mortality rates, and are more likely to be extirpated by random environmental factors.

Species that characteristically have small population sizes, such as large predators or habitat specialists, are more likely to become extinct than species that typically have large populations (Primack 1998). Also, a species with low population density (few individuals per unit area) tends to have only small populations remaining if its habitat is fragmented. Populations of species that naturally occur at lower density become extinct more rapidly than do those of more abundant species (Bolger *et al.* 1991). The species may be unable to persist within each fragment and thus gradually dies out across the landscape.

The beetle, a specialist on elderberry plants, tends to have small population sizes, and to occur in low densities (Barr 1991; Collinge *et al.* in prep.). Collinge *et al.* (in prep.) compared resource use and density of exit holes between the beetle and a related subspecies, the California elderberry longhorn beetle (*Desmocerus californicus californicus*). The beetle tended to occur in areas with higher elderberry densities, but had lower exit hole densities than the California elderberry longhorn beetle. With extensive riparian habitat loss and fragmentation, these naturally small populations are broken into even smaller, isolated populations. Once a small population has been extirpated from an isolated habitat patch, the species may be unable to re-colonize this patch.

Insects with limited dispersal and colonization abilities may persist better in large habitat patches than small patches because small fragments may be insufficient to maintain viable populations and the insects may be unable to disperse to more suitable habitat (Collinge 1996).

Some studies suggest that the beetle is unable to recolonize drainages where the species has been extirpated, because of its limited dispersal ability (Huxel in prep.; Barr 1991; Collinge *et al.* in prep.). Huxel (in prep) used computer simulations of colonization and extinction patterns for the beetle based on differing dispersal distances and found that the short dispersal simulations best matched the 1997 census data in terms of site occupancy. This suggests that in natural-system

dispersal recolonization is limited to nearby sites. At spatial scales greater than 10 km., such as across drainages, beetle occupancy appears to be strongly influenced by regional extinction and colonization processes, and colonization is constrained by limited dispersal (Collinge *et al.* in prep.).

Except for one occasion, drainages examined by Barr (1991) that were occupied in 1991 remained occupied in 1997 (Collinge *et al.* in prep.). The one exception was Stoney Creek, which was occupied in 1991, but not in 1997. All drainages found by Barr (1991) to be unoccupied in 1991 were also unoccupied in 1997. This data suggests that drainages unoccupied by the beetle remain unoccupied.

In addition, recent evidence indicates that the invasive Argentine ant poses a risk to the long-term survival of the beetle. Surveys along Putah Creek found beetle presence where Argentine ants were not present or had recently colonized, but the beetle was absence from otherwise suitable sites where Argentine ants had become well-established (Huxel, in prep.). The Argentine ant has already negatively impacted populations of other native arthropod species (Holway 1998; Ward 1987). Predation on eggs, larvae, and pupae are the most likely impacts these ants have on the beetle. In Portugal, Argentine ants have been found to be significant egg predators on the eucalyptus borer, a cerambycid similar to the beetle. Egg predation on the beetle could lead to local extirpations, as indicated by a population viability study suggesting that egg and juvenile mortality are significant factors affecting probability of extinction for the beetle (Huxel and Collinge, in prep.). The Argentine ant has been expanding its range throughout California since its introduction around 1907, especially in riparian woodlands associated with perennial streams (Holway 1998; Ward 1987). Huxel (in prep.) concluded that, given the potential for Argentine ants to spread with the aid of human activities such as movement of plant nursery stock and agricultural products, this species may come to infest most drainages in the Central Valley along the valley floor, where the beetle is found.

Another potential harmful factor for the beetle is direct spraying with pesticides and related pesticide drift. A wide range of such spraying is done to control mosquitoes, crop diseases, and undesirable plants and insects. Although there have been no studies specifically focusing on the direct and indirect effects of pesticides, on the beetle, evidence suggests that the species may be adversely affected by some pesticide applications. As of 1980, the prevalent land-use adjacent to riparian habitat in the Sacramento Valley was agriculture, even in regions where agriculture was historically not generally the most common land use (Katibah *et al.* 1984), therefore the species is likely vulnerable to pesticide contamination from an array of agricultural pesticide application practices. Recent studies of major rivers and streams documented that 96 percent of all fish, 100 percent of all surface water samples and 33 percent of major aquifers contained one or more pesticides at detectable levels (Gilliom 1999). Pesticides were identified as one of the 15 leading causes of impairment for streams included on the Clean Water Act section 303(d) lists of impaired waters. Because the beetle occurs primarily in riparian habitat, the contamination of rivers and streams likely has affects on this species and its habitat. Pesticides have been identified as one of a number of potential causes of pollinator species' declines and declines of other insects beneficial to agriculture (Ingraham *et al.* 1996); therefore, it is likely that the beetle, typically occurring adjacent to agricultural lands, has harmful effects due to pesticides.

Also, competition from invasive exotic plants, such as giant reed (*Arundo donax*), negatively affects riparian habitat supporting the beetle. Giant reed, a native of Asia, has become a serious problem in California riparian habitats, forming dense, homogenous stands essentially devoid of wildlife. Giant reed can grow up to 2.5 inches per day and yield 8.3 tons of oven-dry cane per acre; it also tolerates drought, floods, and extreme temperatures, and is not significantly affected by insects, disease, herbivory, fire, or mechanical disturbance. It has an extensive root system allowing it to resprout rapidly after any disturbance and it easily out-competes native riparian vegetation. Giant reed also introduces a frequent fire cycle into the riparian ecosystem, disrupting natural riparian dynamics and eventually forming homogenous climax communities. Although giant reed has become extensively distributed throughout the Central Valley and along its waterways, the extent to which it has negatively affected elderberries and the beetle is not specifically known

Another potential factor in the beetle's decline is the effects of adverse livestock grazing practices, which can result in destruction of entire elderberry plants and inhibition of elderberry regeneration. Cattle, sheep and goats readily forage on new elderberry growth, and goats will consume even decadent growth. Well-manicured stands of elderberries, such as occurs due to livestock grazing, have generally been shown to have a relative absence of beetles (Service 1984). The effects on the beetle of both grazing and exotic plant invasions are likely significantly exacerbated by the problem of habitat fragmentation of elderberries. Such fragmentation increases the edge:interior ratio of habitat patches, thereby facilitating the adverse effects of these outside influences.

The American River Zone is considered essential habitat for the recovery of the valley elderberry longhorn beetle. The project site contains several elderberry shrubs with stems one inch in diameter at ground level. Therefore, given its biology and ecology, the presence of suitable habitat, the Service has concluded the beetle likely inhabits the action area.

EFFECTS OF THE PROPOSED ACTION

Biologists from the COE and the Service conducted surveys for the presence of the beetles, exit holes, and elderberry shrubs in the project area on December 22, 2004, March 10, 2005, and April 4, 2005. Results of the surveys indicated that construction activities in the areas could affect a total of 15 elderberry shrubs with at least one stem greater than or equal to 1 inch in diameter at ground level. This includes all shrubs within the 100-foot buffer area required by the Service. These shrubs would be indirectly affected by dust or vibration from construction activities within the buffer zone. Additionally, beetle nurseries and mating behaviors would also be indirectly affected. Therefore, the Service has determined that the proposed material borings will have adverse effects to elderberry shrubs and therefore, the beetle.

All 15 shrubs would be indirectly affected by the temporary access road construction activities and the borings, however, 3 of those shrubs are also expected to be directly affected by the proposed bridge construction, scheduled to begin in 2006. The COE proposes to compensation at a rate 3.5x the normal compensation rate and be applied in the form of elderberry seedlings and associated native plants as directed in the Guidelines. The compensation for the three shrubs expected to be directly affected by the bridge construction will be deferred until the bridge consultation is conducted. This deferment does not change or lessen the compensation required. Table 1 and Table 2 summarize all the compensation required for the proposed material borings project.

Table 1. Compensation for indirect affects of the proposed Material Borings project.

Location	Stems (maximum diameter at ground level)	Exit Hole on Shrub (Yes or No)	Elderberry Seedling Ratio	Associated Native Plant Ratio	Number of Stems Observed	Required Elderberry Plantings	Required Associated Native Plant Plantings
Non-riparian	stems ≥1" & ≤3"	No	3.5:1	1:1	2	7	2
Non-riparian	stems >3" & <5"	No	7:1	1:1	7	49	14
Non-riparian	stems ≥5"	No	10.5:1	1:1	21	220.5	63
Total					30	276.5	276.5
Total Elderberry shrubs affected					15		
Compensation area required for the plantings based on the 3.5x normal compensation rate						2.285	

Table 2. Compensation for indirect affects of the proposed Material Borings that will be deferred and included in the proposed upcoming bridge project.

Location	Stems (maximum diameter at ground level)	Exit Hole on Shrub (Yes or No)	Elderberry Seedling Ratio	Associated Native Plant Ratio	Number of Stems Observed	Required Elderberry Plantings	Required Associated Native Plant Plantings
Non-riparian	stems ≥1" & ≤3"	No	3.5:1	1:1	8	28	28
Non-riparian	stems >3" & <5"	No	7:1	1:1	2	14	14
Non-riparian	stems ≥5"	No	10.5:1	1:1	7	73.5	73.5
Total					17	115.5	115.5
Total Elderberry shrubs affected					3		
Compensation area required for the plantings based on the 3.5x normal compensation rate.						0.955	

Mitigation for the proposed project would occur at the American River Watershed Project mitigation site (Rossmoor Site) along the lower American River in accordance with the Guidelines.

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.

Continued human population growth in the Central Valley, in general, and the Sacramento area, in particular, is expected to drive further development of agriculture, cities, industry, transportation, and water resources in the foreseeable future. Some of these future activities will not be subject to Federal jurisdiction (and thus are considered to enter into cumulative effects), and are likely to result in loss of riparian and other habitats where elderberry shrubs and the beetle occur.

Many of activities affecting the beetle involve impacts to elderberry shrubs located within riparian ecosystems adjoining or within jurisdictional wetlands. These projects will be evaluated via formal consultation between the Service and the COE via the Federal nexus provided by section 404 of the Clean Water Act.

A number of projects have no need to discharge dredged or fill material into waters of the U.S. These projects, for which no section 404 permit is required, may lack a Federal nexus and thus, move forward absent formal consultation. These projects pose a significant threat to the recovery of the beetle, particularly when they result in the removal of elderberry savannah ecosystems. These foothill/upland landscapes often consist of mixed stands of elderberry shrubs and oak (*Quercus* spp.) trees which are interspersed with open grasslands in a savannah-like arrangement. Elderberry shrubs in these savannah systems often achieve great size, due perhaps to the lack of light competition from broadleaf trees and/or entanglement with California grape (*Vitus californica*) and/or Himalayan blackberry (*Rubus discolor*) vines, as often occurs in riparian communities. Elderberry savannah communities are important in that they represent a large portion of the diverse habitat in which elderberry shrubs occur and because urban sprawl threatens a significant acreage of these systems. This loss of habitat negatively affects the environmental baseline and is difficult to quantify.

Conclusion

After reviewing the current status of the beetle, the environmental baseline for the action area, the effects of the material borings and road construction activities of the proposed project and the cumulative effects, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the beetle. Critical habitat has been designated for the beetle but none exists in the action area; therefore, no beetle critical habitat will be adversely modified or destroyed.

INCIDENTAL TAKE STATEMENT

Section 9 of the Act and Federal regulation pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harass is defined by the Service as an intentional or negligent act or omission which creates the likelihood of injury to a listed species by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding or sheltering. Harm is defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by impairing behavioral patterns including breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking 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 nondiscretionary for listed species in this opinion and must be implemented by the COE in order for the exemption in section 7(o)(2) to apply. The COE has a continuing duty to regulate the activity that is covered by this incidental take statement. If the Federal agency (1) fails to adhere to the terms and conditions of the incidental take statement, 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

Valley Elderberry Longhorn Beetle

The Service expects that incidental take of the beetle will be difficult to detect or quantify. The cryptic nature of these species and their relatively small body size make the finding of an injured or dead specimen unlikely. The species occurs in habitats that make them difficult to detect. Due to the difficulty in quantifying the number of beetles that will be taken as a result of the proposed action, the Service is quantifying take incidental to the project as death, injury, harassment, and harm of all beetles inhabiting or otherwise utilizing the 15 elderberry shrubs with stems one inch or greater in diameter at ground level, as described in this biological opinion and the Environmental Assessment.

Effect of the Take

The Service has determined that this level of anticipated take in this opinion is not likely to result in jeopardy to the beetle or result in destruction or adverse modification of its critical habitat.

Reasonable and Prudent Measures

The following reasonable and prudent measures are necessary and appropriate to minimize the effect of the proposed Material Boring Project, as described, on the beetle.

1. The COE shall implement the project as proposed in their April 11, 2005, letter and this biological opinion.

2. Effects of harassment of individual beetles, and of the loss and degradation of the species' habitat shall be minimized.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the Act, the COE must ensure that the proposed project complies 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. The COE shall minimize the potential for incidental take of the beetle resulting from the project related activities by implementation of the conservation measures as described in the environmental assessment and the project description of this biological opinion.

    b. The COE shall include a copy of this biological opinion within its solicitations for construction of the project, making the prime contractor responsible for implementing all requirements and obligations included in this biological opinion and to educate and inform all other contractors involved in the project as to the requirements of this biological opinion. A copy of the solicitations containing the biological opinion will be provided to the Chief of Endangered Species (Central Valley) at the Service's Sacramento Fish and Wildlife Office.

2. The following terms and conditions implement Reasonable and Prudent Measure number two (2):

    a. The procedures outlined in the Service's *Conservation Guidelines for the Valley Elderberry Longhorn Beetle* dated July 9, 1999, shall be followed for all actions related to the proposed project unless otherwise stated below.

    b. The establishment of the elderberry and associated native plant seedlings must occur between September 1, 2004 and February 15, 2005.

    c. The COE shall ensure that the elderberry and associated native plant seedlings are established on no less than 2.28 acres at a Service approved site.

    d. As described above the COE maintains responsibility for the deferred compensation of the 33 elderberry planting and 33 associated native plant planting and ensure that they are included in the proposed bridge project.

e. If requested, the COE or their representative shall allow access to the project site by the Service or the California Department of Fish and Game to assess the effects of the project on the beetle.

Reporting Requirements

A post-construction compliance report prepared by the monitoring biologists shall be prepared and forwarded to the Service within 60 calendar days of the completion of construction activity. This report shall detail (i) dates that construction occurred; (ii) pertinent information concerning the success of the Project in meeting compensation and other conservation measures; (iii) an explanation of failure to meet such measures, if any; (iv) known project effects on federally listed species, if any; (v) occurrences of incidental take of federally listed species, if any; and (vi) other pertinent information.

The Service shall be notified immediately by facsimile or telephone and in writing within one (1) working day of any unanticipated take of beetle, and of the take or suspected take of listed wildlife species not authorized in this opinion. Notification must include the date, time, and location of the incident of the incident or of the finding of a dead or injured animal, and any other pertinent information. The Service contact persons are the Chief of the Endangered Species Division, at (916) 414-6600 and the Resident Agent-in-Charge of the Service's Law Enforcement Division at (916) 414-6660.

Any dead or injured beetles must be relinquished to the Service. Any killed species that have been taken shall be properly preserved in accordance with the techniques recommended by the Entomology Department of the California Academy of Sciences. Information concerning how the animal was taken, length of the interval between death and preservation, and any other relevant information should be written on 100% rag content paper with permanent ink and included in the container with the specimen. Preserved specimens shall be delivered to the Service's Division of Law Enforcement at 2800 Cottage Way, Room W-2928, Sacramento, California 95825-1846, phone (916) 414-6660.

Proof of environmental training and fulfillment of compensation requirements shall be delivered to the Chief of the Endangered Species Division, Sacramento Fish and Wildlife Office, 2800 Cottage Way, Room W-2605, Sacramento, California, 95825-1846.

Reporting requirements for the beetle are found in the "Monitoring" section of the 1999 Conservation Guidelines for this species. The reports shall be combined, where applicable, with the reporting requirements for other species and the experimental conservation measures, where appropriate.

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.

1. The COE should work with the Service to address significant, unavoidable environmental impacts to federally-listed species approved by local agencies.
2. The COE should assist the Service in the implementation of recovery efforts for the beetle.

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

REINITIATION NOTICE

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

If you have any questions regarding this biological opinion please contact Stephanie Rickabaugh or the Acting Sacramento Branch Chief at (916) 414-6600.

Sincerely,

Ken Sanchez
Acting Field Supervisor

cc:
Jane Rinck, U.S. Army Corps of Engineers, Sacramento, California
Dee Warenycia, California Department of Fish and Game, Sacramento, California

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United States Department of the Interior

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Sacramento, California 95825-1846

In reply refer to:
1-1-05-F-0222

AUG 15 2005

Thomas E. Trainer
Chief, Planning Division
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Subject: Amendment to the Service's Biological Opinion for the Proposed Material Borings for the American River Watershed Folsom Bridge Project, Sacramento County, California

Dear Mr. Trainer:

This is in response to a July 29, 2005, letter from the U.S. Army Corps of Engineers (COE) to the U.S. Fish and Wildlife Service (Service), identifying delays in the project and changes to the indirect effects on the federally listed valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (beetle) in the May 4, 2005, biological opinion for the Proposed Material borings for the Folsom Bridge Project, Sacramento County, California (project) (Service File Number 1-1-05-F-0108). Your letter was received in our office on August 1, 2005. This letter revises the proposed compensation for direct and indirect affects of the proposed project and amends the project's biological opinion, as appropriate.

The findings and recommendations in this consultation are based on: (1) the July 29, 2005, electronic correspondence letter from Jane Rinck (COE) to Stephanie Rickabaugh (Service), requesting an amendment to the project's biological opinion; (2) the July 12, 2005, site visit; (3) the August 4, 2005, telephone conversation between Jane and Stephanie clarifying the proposed compensation ratios and (4) other information available to the Service.

Due to project delays some of the boring activities scheduled to be completed in June 2005, were not completed until August 5, 2005. On the south (and east) side of the American River the boring activities began on July 18, 2005, and will be completed by August 5, 2005. The remaining project activities and description are the same; however, the COE has proposed reducing the compensation rate from 3.5x the normal ratio to 2.5 times the normal ratio for

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adverse affects to the beetle and thus the elderberry shrubs (*Sambucus* spp.) (shrub) on the south side of the river. This decrease in the compensation ratio for these 14 shrubs that are indirectly affected by the proposed project is because the construction activities would take place outside the transplant window but no longer during the beetles' emergence period.

The May 4, 2005, biological opinion is now amended to read:

Page 4: Description of the Proposed Action, paragraph 2 from: The COE proposes to compensate for adverse affects from the proposed material borings project at a rate 3.5x the normal compensation because the work is being done during the beetle's flight period when the beetles are vulnerable to dust and disturbance. However, the COE requests that the compensation for the three shrubs directly affected by the proposed bridge project be included in the subsequent bridge consultation. This subsequent compensation for the three shrubs has been agreed to by the Service.

To: For boring activities occurring before June 30, 2005, the COE proposes to compensate for adverse affects from the proposed material borings project at a rate 3.5x the normal compensation because the work is being done during the beetle's flight period when the beetles are vulnerable to dust and disturbance. For boring and construction activities occurring between July 18, 2005 and August 5, 2005, the COE proposed to compensate for adverse affects from the proposed material borings project at a rate 2.5x the normal compensation because the work is being done outside of the normal transplant window. However, the COE requests that the compensation for the three shrubs directly affected by the proposed bridge project be included in the subsequent bridge consultation. This subsequent compensation for the three shrubs has been agreed to by the Service.

Page 5: Proposed Minimization Measures, last paragraph from: Elderberry plants for which impacts cannot be avoided shall be compensated for, at a rate 3.5x the normal rate and following the criteria set forth in Table 1 of the Guidelines, as modified by the Service. These guidelines provide for transplanting and planting of elderberries, as well as planting of associated riparian vegetation.

To: Elderberry plants shall be compensated for, at a rate 3.5x the normal rate for which adverse effects cannot be avoided April through June 2005, and 2.5x the normal rate for which adverse effects cannot be avoided July 18 through August 2005, and following the criteria set forth in Table 1 of the Guidelines, as modified by the Service. These guidelines provide for transplanting and planting of elderberries, as well as planting of associated riparian vegetation.

Page 12: Effects of the Proposed Action, paragraph 2 from: All 15 shrubs would be indirectly affected by the temporary access road construction activities and the borings, however, 3 of those shrubs are also expected to be directly affected by the proposed bridge construction, scheduled to begin in 2006. The COE proposes to compensation at a rate 3.5x the normal compensation rate and be applied in the form of elderberry seedlings and associated native plants as directed in the Guidelines. The compensation for the three shrubs expected to be directly affected by the bridge construction will be deferred until the bridge consultation is conducted. This deferment does not change or lessen the compensation required. Table 1 and Table 2 summarize all the compensation required for the proposed material borings project.

To: All 15 shrubs would be indirectly affected by the temporary access road construction activities and the borings, however, 3 of those shrubs are also expected to be directly affected by the proposed bridge construction, scheduled to begin in 2006. The COE proposes to compensate at a rate 3.5x and 2.5x the normal compensation rate and be applied in the form of elderberry seedlings and associated native plants as directed in the Guidelines. The compensation for the three shrubs expected to be directly affected by the bridge construction will be deferred until the bridge consultation is conducted. This deferment does not change or lessen the compensation required. Table 1 and Table 2 summarize all the compensation required for the proposed material borings project.

Page 12: Effects of the Proposed Action, Replace Table 1, with the following;

Table 1. Compensation for indirect affects occurring on the south side of American River, for the proposed Material Borings project.

Location	Stems (maximum diameter at ground level)	Exit Hole on Shrub (Yes or No)	Elderberry Seedling Ratio	Associated Native Plant Ratio	Number of Stems Observed	Proposed Elderberry Plantings	Proposed Associated Native Plant Plantings
Non-riparian	stems ≥1" & ≤3"	No	2.5:1	1:1	2	5	5
Non-riparian	stems >3" & <5"	No	5:1	1:1	7	35	35
Non-riparian	stems ≥5"	No	7.5:1	1:1	21	157.5	157.5
Total					30	197.5	197.5
Total Elderberry shrubs affected					14		
Compensation area required for the plantings based on the 2.5x normal compensation rate						1.63	

Page 15: Terms and Conditions, Number 2B, Omit: The establishment of the elderberry and associated native plant seedlings must occur between September 1, 2004, and February 15, 2005.

Page 15: Terms and Conditions, Number 2C from: The COE shall ensure that the elderberry and associated native plant seedlings are established on no less than 2.28 acres at a Service approved site.

To: The COE shall ensure that the elderberry and associated native plant seedlings are established on no less than 1.63 acres at a Service approved site.

The other portions of the project description, species, baseline, effects analysis, conclusion, incidental take, reasonable and prudent measures, and conservation recommendations in the May 4, 2005, biological opinion remains the same.

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

Please contact Stephanie Rickabaugh or the Acting Sacramento Valley Branch Chief at (916) 414-6724 if you have questions regarding this amendment to the biological opinion.

Sincerely,

Kenneth Sanchez
Acting Field Supervisor

cc:
Jane Rinck, U.S. Army Corps of Engineers, Sacramento, California
Dee Warenycia, California Department of Fish and Game, Sacramento, California

United States Department of the Interior

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

In reply refer to:
1-1-06-I-0335

JAN 3 2006

Mr. Brandon C. Muncy
Chief, Planning Division
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Subject: Review of Proposed Additional Geotechnical Work Associated with the Folsom Dam Bridge, Sacramento County, California

Dear Mr. Muncy:

This letter is in response to the U.S. Army Corps of Engineers' December 20, 2005, request for concurrence that conducting additional core borings to determine the material conditions and engineering properties associated with the bridge construction, as part of the Folsom Dam Bridge Bypass Project (proposed action), is not likely to adversely affect listed species. Your request was received by the U.S. Fish and Wildlife Service (Service) on December 21, 2005. At issue are the potential effects of the proposed project on the federally-listed valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (beetle). Our primary concern and mandate is the protection of federally-listed species pursuant to the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*) (Act).

We have reviewed the proposed action, including: (1) your December 20, 2005, letter initiating section 7 consultation with the Service; (2) the May 4, 2005, biological opinion (1-1-05-F-0108) and August 15, 2005, amendment (1-1-05-F-0222) issued for the proposed project; and (3) other information available to the Service.

The additional three or four core borings would be about 30 to 50 feet deep and take between three to four weeks to complete. The proposed action would include two core borings for Pier 2 on the north side of the American River and one core boring for Pier 3 on the south side of the American River. A forth core boring maybe needed for Pier 3, depending on the results of a test pit excavation during drill pad preparation. The locations of the new proposed boring are within the same vicinity as the borings completed in August 2005. Access to the proposed boring locations would be via existing roads and by helicopter. The existing access road to Pier 3 would need to be improved for access during wet weather. This includes the transport and placement of crushed rock along 400 feet of the road.

TAKE PRIDE IN AMERICA

The proposed project site contains 15 elderberry shrubs (*Sambucus* sp.) which is the sole host plant for the valley elderberry longhorn beetle. Only two are within 75 feet of the proposed project site and both remain fenced from the earlier boring activity. Activities associated with the proposed action would be completed by February 15, 2006, during the elderberry shrubs' dormant season and the non-flight season for the beetle. Significant dust is not expected because the proposed action would occur during the winter season and because the shrubs are located in a very rocky area with little exposed soil. Additionally, because of the small range and relative brevity of the boring activity, the Service concurs with your determination that the proposed project will not adversely affect the beetle. Therefore, unless new information reveals effects of the proposed action that may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed action, no further action pursuant to the Act is necessary.

If you have questions regarding the proposed Additional Geotechnical Work Associated with the Folsom Dam Bridge Project, please contact Stephanie Rickabaugh or Mary Hammer, the Acting Sacramento Valley Branch Chief, at (916) 414-6724.

Sincerely,

Peter A. Cross

Peter A. Cross
Deputy Assistant Field Supervisor

cc:
AES, Portland, OR
Jane Rinck, COE, Sacramento, CA

COST EFFECTIVENESS/INCREMENTAL COST ANALYSIS

FOLSOM BRIDGE PROJECT

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INCREMENTAL COST ANALYSIS FOR MITIGATION

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INCREMENTAL COST ANALYSIS FOR MITIGATION

1.0 PURPOSE

The purpose of the incremental cost analysis is to evaluate mitigation alternatives to compensate for project-related adverse effects to biological resources resulting from the Folsom Dam Bridge Project. By applying the findings of this analysis, the project proposes to compensate for adverse effects in the most cost-effective manner.

Guidance for developing this incremental cost analysis comes from Engineer Regulations (ER) 1105-2-100 and 1105-2-50, Engineer Circular 1105-2-185, and the Institute for Water Resources Report 94-PS-2. The goal of this analysis is to develop, through the economic justification of mitigation alternatives, the "least-cost plan" that still fully compensates for project-related effects. The analysis is a two-step process. First, a cost-effectiveness analysis is done to ensure that the least-cost solution is identified for each possible level of environmental mitigation output. This step eliminates economically inefficient and ineffective mitigation solutions. Second, an incremental cost analysis of the least-cost solutions is done to show changes in costs for increasing levels of environmental mitigation output. This second step is termed "justifying the last-added increment of mitigation effort." IWR Plan Software version 3.3 was used for this analysis.

The environmental output analysis is based on habitat evaluation procedures (HEP) that define the relationship between increasing habitat value with each increase in compensation increment features and increases in environmental output. The analysis then compares successive environmental outputs and associated incremental increases in costs. Compensation measures (increments) for each significant habitat are then combined to show their cumulative increase in environmental output and cost. Combinations of increments are developed for each habitat that approximate the habitat value replacement goal developed during the HEP. Each grouping of compensation measures for each habitat type is then combined with other habitat-specific increments to become mitigation proposals for one or more proposed mitigation sites, each of which is habitat specific. Decisions could then be made on selecting the proposal(s) that compensate for adverse effects while being cost effective and incrementally justified.

Under the provisions of the Fish and Wildlife Coordination Act, the U.S. Fish and Wildlife Service (FWS) has prepared a draft coordination act report (Draft CAR) that includes the HEP analysis for this project. The purpose of the Draft CAR is to assess project-related effects to biological resources in the project area. This incremental analysis reflects the findings of the HEP report and incorporates the mitigation strategy developed by the HEP team that identifies the important biological resources that should be included in the analysis. A major purpose of this incremental analysis is documenting the "steps" taken in identifying mitigation alternatives and developing a recommended compensation plan. The incremental analysis helps ensure compliance with the statutory requirements of the Fish and Wildlife Coordination Act and agency regulations, both of which state that the project proponents give full consideration to Federal and State agency comments and recommendations resulting from resource agency consultation.

2.0 ENVIRONMENTAL VALUES

The project area is located within the 6-mile area between Folsom Dam and Nimbus Dam. Most of the land in this area is owned by either the Federal Government of the State of California and is generally undeveloped. Because this area is largely owned by the government and is close to Folsom Prison, the area will likely remain in its undeveloped state. Most of the project area was disturbed during the construction of Folsom Dam. The existing habitat is the area has reestablished after the dam was completed.

The project area currently supports the following habitat types: oak woodland, riparian woodland, seasonal wetland, chaparral, and annual grassland. In addition, disturbed areas with various species of nonnative vegetation are found around roadways and facilities in the project area.

Oak woodland is the predominant habitat type in the project area, consisting of mostly blue oak, interior live oak, some valley oak, buckeye, and an understory of annual grassland species. Smaller areas of riparian woodland and seasonal wetlands are also found. Riparian areas have sparse vegetation including various willow species and Fremont cottonwood. Seasonal wetland species include cattail, blackberry, soft chess brome, perennial rye grass, curly dock, and various willow species. Common chaparral species include manzanita and chemise, while understory species include poison oak, California wild rose, and lupine. Nonnative grassland species include wild oats, soft brome, ryegrass, mustard, and foxtail. In additional, there are numerous elderberry shrubs associated with the oak woodland and nonnative grassland habitats in the project area.

The habitats in the project area support various wildlife species. Mammal species include mule deer, coyote, bobcat, gray fox, black-tailed jackrabbit, Virginia opossum, striped skunk, and a variety of rodents. Common bird species in the project area include acorn woodpecker, Nuttall's woodpecker, loggerhead shrike, western wood pewee, scrub jay, Bullock's oriole, California quail, introduced wild turkeys, and plain titmouse. Common raptors include red-tailed hawk, American kestrel, prairie falcon, great horned owl, and bald eagle. Reptile and amphibian species likely found in the project area include western fence lizard, gopher snake, western rattlesnake, common kingsnake, Pacific treefrog, and western toad.

The presence of year-round water provides habitat for many water-associated species such as raccoon, Canada geese, wood duck, common merganser, mallard, black phoebe, great blue heron, greater yellowlegs, belted kingfisher, and common yellowthroat. Areas dominated by annual grassland provide foraging habitat and cover for California ground squirrel, pocket gopher, turkey vulture, coyote, western fence lizard, western rattlesnake, western kingbird, and western meadowlark.

3.0 Project-Related Effects Requiring Mitigation

A HEP analysis was performed to determine potential adverse effects within the project area. A HEP analysis is a habitat-based evaluation methodology developed for use in adverse effect assessment and mitigation planning. A HEP analysis is based on the assumption that the value of a habitat for selected species or the value of a community can be described in a model, which produces a Habitat Suitability Index (HSI). This HSI value (from 0.0 to 1.0) is multiplied by the area of available habitat to obtain Habitat Units (HUs). HUs are converted to Average Annual Habitat Units (AAHUs) or an annualized computation of HUs expressed as a derivation of habitat value across all years in the economic life of the project. The HUs and AAHUs, over the life of the project, are then used in the following comparisons: (1) the relative value of different areas at the same point in time; and (2) the relative value of the same areas at future points in time. By combining the two types of comparisons, various project-related effects can be quantified. This information can also be used for mitigation planning to identify compensation needs. Additional information on the HEP and associated HSI models used for this project can be found in Appendix A of the FWS Draft CAR, Appendix B. Table 1 provides acres impacted by habitat type, AAHUs lost, and the compensation objectives. Additional information on project effects can be found in Chapter 4.0 of the SEIS/EIR.

Table 1. Project Related Adverse Effects

Habitat Type	Acres Effected	AAHU's Lost	Compensation Objective (acres)[1]
Oak woodland	32.87	33.87	50.10
Riparian woodland	5.46	8.32	5.80
Seasonal Wetland	2.51	1.20	2.51
Annual Grassland	N/A	N/A	N/A
Other	N/A	N/A	N/A

N/A =Not Applicable

1 Extent of compensation habitat required to achieve mitigation based on the HEP analysis.

2 See Section 6.0 "Compensation Strategy Increments" for definitions of compensation increments

4.0 Compensation Objectives

According to ER 1105-2-100, the first step in mitigation planning is to avoid effects if possible and then to minimize adverse effects through design modification. For those project effects that are unavoidable, the compensation objective is to fully restore lost habitat values through reasonable and justifiable in-kind, onsite replacement.

Direct construction impacts are those that would cause immediate and complete loss of habitat values at a particular site at the time of project construction. These immediate impacts would occur in the footprint area of the bridge and roadway and within all temporary and permanent construction easement areas.

Trees and other woody vegetation within temporary construction easement areas would not be reestablished once construction is completed. Impacts to herbaceous vegetation that would occur within staging and borrow areas would be temporary because these areas will be reseeded after construction. All woody vegetation at the staging and borrow areas would be adversely affected. Compensation objectives are provided in Table 1. The compensation objective includes wetlands that are to be "fully mitigated" through actions to avoid, minimize, and compensate for unavoidable losses to meet the goal of no net loss of wetlands, (Water Resources Development Act of 1990, Section 307 (a); ER 1105-2-100, paragraph 7-35g).

In accordance with ER 1105-2-110, project lands (lands required for authorized project purposes) are considered for mitigation purposes first, followed by public lands (lands owned or otherwise legally entrusted to a local, State, or Federal agency), and then private lands. For this project, Federally owned lands were initially considered for the mitigation of all habitat types. However, the site previously identified for mitigation for the American River Long-Term Project, Mormon Island Preserve, is no longer available for mitigation use. Other suitable sites along the Lower American River were considered for compensation. The compensation areas are discussed in the following section.

5.0 Mitigation Sites to Compensate for Habitat Loss

HEP procedures were used to evaluate potential mitigation sites to compensate for habitat losses identified as a result of construction of the project. Habitat values that could be developed on a site were quantified for each of the cover-types impacted. The HEP analysis assumed the compensation sites would not currently support any woody vegetation and would be capable of supporting the cover-type proposed for the site (i.e., a site would have the appropriate hydrology to support seasonal wetlands or riparian cover-types). The preferred sites included lands within the American River Parkway above the levees, downstream of Sunrise Bridge. These lands are owned by Sacramento County Parks. The assumptions used to develop the compensation site scenarios are listed in Appendix A-1 of the FWS Draft CAR.

A specific compensation site was not analyzed in the HEP analysis. Instead a typical site was developed, and assumptions were made that the site would be an annual grassland area without significant existing woody vegetation for a baseline condition. For the riparian and seasonal wetland cover-types, a critical assumption was made that any site selected for compensation would require the appropriate hydrology to support these cover-types. The HEP noted that suitable lands for oak woodland, and riparian woodland were observed at sites for consideration along the American River Parkway.

6.0 Compensation Strategy Increments

According to ER 1105-2-100, a management/compensation plan increment consists of one or more management features. Plan increments may interrelate and complement one another, but they cannot be functionally dependent upon another increment. Low intensity, medium intensity, and high intensity plan increments were developed for the oak woodland, riparian woodland, and seasonal wetland habitat types. These plan increments are made up of one or more management features (or measures). When deciding on compensation strategy increments, the following items were considered.

Two or three increments provide a full range of planning possibilities for mitigation. The possibilities range from little compensation to a logical maximum level of effort while keeping the number of possible measure combinations manageable. Each of the increments can stand alone as a possible mitigation measure. Combining more features into each successive increment is logical since each increment incorporated the previous increment's mitigation features to add its cumulative increase in habitat value. Combining compensation features into the two or three increments and then tailoring the increments to each habitat type being compensated allows the analysis to show the HU gain specific to that habitat.

This analysis compares implementation strategies for one mitigation site, a representative site along the Lower American River Parkway. Three compensation increments were identified for each compensation habitat type:

- Increment 1—minimum (application of low-cost mitigation measures that generally provide fewer AAHUs than more expensive measures);
- Increment 2—moderate (application of moderate-cost mitigation measures that generally provide fewer AAHUs than more expensive measures, but provide more AAHUs than lower cost measures); and
  Increment 3—maximum (application of high-cost mitigation measures that generally provide greater AAHUs than low and moderate increments).

The compensation increments vary in the level of effort (i.e., labor, materials, equipment, and other cost-related items) required to implement each compensation increment and, as a result of different levels of effort, would be expected to provide varying levels of output in the form of AAHUs generated. The compensation increments for each habitat type are summarized in Tables 2, 3, and 4.

The results of the analysis are expressed as the absolute per-acre AAHUs provided by each compensation increment for each mitigated habitat and per-acre mitigation cost per AAHU generated under each of the increments for each habitat.

The cost of each compensation increment for each compensation habitat type is calculated based on the combined costs of its mitigation features multiplied by the mitigation site acreage needed to compensate project impacts. Compensation costs were then compared by increment. This comparison allows an analysis of each compensation increment's cost compared to its increase in HSI values. Compensation increments with varying compensation measures were developed for each of the main habitat types affected by project work.

Specific criteria were developed for each habitat type to ensure the success of the low to the high intensity compensation increments. These criteria remained constant throughout the analysis and are essential to the long-term biological success of the compensation.

Costs for the criteria listed below are included in the compensation costs of each increment with the exception of monitoring, access/maintenance roads, and developing the Operations and Maintenance manual (O&M manual. No long-term maintenance, monitoring, or contingency costs were included in these cost estimates. The cost estimates do not include any costs associated with vegetation, hydrology, or wildlife monitoring surveys and are based on estimates prepared for similar projects

- Oak Woodland—Dedicate lands (currently annual grasslands); prepare annual grasslands for planting; provide access and maintenance roads; assume 10% mortality for each of first 3 years; assume maximum growth rate of 12 inches/year; and develop O&M manual.
- Riparian Woodland—Dedicate lands; prepare annual grasslands for planting; provide access and maintenance roads; grade site to facilitate natural seasonal flooding; assume maximum growth rate of 12 inches/year; and develop O&M manual.
- Seasonal Wetland—Dedicate lands (proposed site baseline is Condition C wetland); design portion of wetland to have permanent water; do not stock carp; provide access and maintenance roads; plant cover crop on all disturbed non-wetland areas; and develop O&M manual.

Table 2. Oak Woodland Compensation Plan—Increments 1-3

Compensation Increments	Description
Increment 1 – Low Intensity	Plant 500 acorns per acre; do not irrigate or provide plant protection; monitor plant survival and replant acorns as necessary to maintain 250 trees per acre
Increment 2 – Moderate Intensity	Plant 400 trees (4"x4"x10" size) per acre (live and blue oaks); seed cover crop; provide site specific irrigation system; provide watering, weeding, and pest control as needed for 3 years; provide general maintenance and cleanup into perpetuity; monitor for 3 years and replant to ensure <10% mortality
Increment 3 – High Intensity	Plant 600 trees (4"x4"x10" size) per acre (90% blue and live oaks and 10% gray pine); seed cover crop; provide site specific irrigation system; provide watering, weeding, and pest control as needed for 3 years; provide general maintenance and cleanup into perpetuity; monitor for 3 years and replant to ensure <10% mortality

Table 3. Riparian Woodland Compensation Plan—Increments 1-3

Compensation Increments	Description
Increment 1 – Low Intensity	Allow site to revegetate naturally; grade site to facilitate natural seasonal flooding
Increment 2 – Moderate Intensity	Plant 200 trees (4"x4"x10" size) per acre as overstory (oak, cottonwood, and willow trees) and 200 understory shrubs (4"x4"x10" size) per acre (wild rose and wild grape); seed cover crop; grade site to facilitate natural seasonal flooding; provide site specific irrigation system; provide watering, weeding, and pest control as needed for 3 years; provide general maintenance and cleanup into perpetuity; monitor for 3 years and replant to ensure <10% mortality
Increment 3 – High Intensity	Plant 400 trees (4"x4"x10" size) per acre as overstory (oak, cottonwood, and willow trees) and 400 understory shrubs (4"x4"x10" size) per acre (wild rose and wild grape); seed cover crop; grade site to facilitate natural seasonal flooding; provide site specific irrigation system; provide watering, weeding, and pest control as needed for 3 years; provide general maintenance and cleanup into perpetuity; monitor for 3 years and replant to ensure <10% mortality

Table 4. Seasonal Wetland Compensation Plan—Increments 1-3

Compensation Increments	Description
Increment 1 – Low Intensity	Grade site to facilitate natural flooding to maintain 20% of wetland area with 4-9 inch deep water throughout the summer; allow site to naturally revegetate; plant cover crop on disturbed upland areas
Increment 2 – Moderate Intensity	Grade site to maintain 20% of wetland area with 4-9 inch deep water throughout the summer; plant wetland plugs 12 inches on center over 80% of the wetland area; plant cover crop on disturbed upland areas; provide site specific irrigation system; provide watering, weeding, and pest control as needed for 3 years or until site is self-sustaining; provide general maintenance and cleanup into perpetuity
Increment 3 – High Intensity	Grade site to maintain 40% of wetland area with 4-9 inch deep water throughout the summer; plant wetland plugs 12 inches on center over 60% of the wetland area; plant cover crop on disturbed upland areas; provide site specific irrigation system; provide watering, weeding, and pest control as needed for 3 years or until site is self-sustaining; provide general maintenance and cleanup into perpetuity

7.0 General Assumptions Used

To conduct this analysis, HEP-generated AAHUs provided by the FWS in the Draft CAR were used. The FWS generated AAHUs for one compensation increment for each habitat type. Compensation increments analyzed in the Draft CAR include the following:

Oak woodland—Increment 2
Riparian woodland—Increment 2
Seasonal wetland—Increment 3

Therefore, to make comparisons among the compensation increments for each habitat type, AAHUs were generated for the remaining increments using the HSI models in the HEP analysis, in consultation with FWS based on the following criteria:

- **Oak woodland–Increment 1.** Increment 1 includes planting acorns without supplemental irrigation for establishment and, therefore, a longer period would be required for trees to establish than under Increment 2. Consequently, it is assumed that Increment 1 will accrue habitat values at 25% of the rate of Increment 2.
- **Oak woodland-Increment 3.** Increment 3 increases the planting density 150 % above Increment 2, therefore it is assumed the tree canopy will increase more rapidly than under Increments 1 and 2.
- **Riparian woodland–Increment 1.** Increment 1 allows for natural regeneration of the riparian plant community and, therefore, it will take considerably longer for Increment 1 to develop shrub crown cover and forest overstory. Consequently, it is assumed that Increment 1 will accrue habitat values at 10% of the rate of Increment 2.
- **Riparian woodland–Increment 3.** Increment 3 increases the planting density of both shrub and overstory species. It was estimated that 10 years after planting, Increment 2 would have 25% shrub cover while Increment 3 would have 50% shrub cover. In the HSI model used for this habitat type, values for this variable drop once 50% shrub crown cover is reached, therefore Increment 3 was given a lower value than Increment 2.
- **Seasonal wetland–Increment 1.** Increment 1 would develop volunteer vegetation 50% as fast as planted vegetation in Increment 3.
- **Seasonal wetland–Increment 2.** Increment 2 would be constructed to provide approximately 50% the open water area as Increment 3 (i.e., more area would be planted with wetland species in Increment 2 and less area would be open water).

8.0 Mitigation Comparisons and Cost Effectiveness

The extent of compensation habitat required to fully compensate impacts on habitat for each compensation increment is presented in Table 5. The AAHUs and compensation acres shown in Table 1 are for Increment 3 of the seasonal wetland compensation plan and Increment 2 for the remaining habitat types and are based on the HEP analysis conducted for the Draft CAR. Per acre AAHUs that would be generated with implementation of Increments 1 and 2 for seasonal wetland and with implementation of Increments 1 and 3 for the remaining habitat types were estimated n consultation with FWS based on:

- professional experience with conducting HEP analyses,
- an assessment of how each of the compensation increments would effect outputs of the HSI models used by the FWS to conduct the Draft CAR HEP analysis,
- assumptions about the rate at which key habitat variables would develop under each of the compensation increments relative to assumptions used for the increments analyzed in the Draft CAR HEP analysis.

Total compensation costs and per acre compensation costs for each increment and habitat type are presented in Table 6. While cost of average annual habitat units per acre are shown in Table 7.

Table 5. Mitigation Acreage Comparisons for Each Habitat Type

Habitat Type	AAHUs Needed for Compensation	Average Annual Habitat Unit Gain					
		Increment 1		Increment 2		Increment 3	
		AAHU Gain (per acre)	Compensation Objective (acres)	AAHU Gain (per acre)	Compensation Objective (acres)	AAHU Gain (per acre)	Compensation Objective (acres)
Oak Woodland	33.87	0.17	199.2	0.67	50.10	0.89	38.1
Riparian Woodland	8.32	0.14	59.4	1.43	5.80	1.22	6.82
Seasonal Wetland	1.20	0.24	5.0	0.59	2.03	0.48	2.51

Notes: AAHU = Average Annual Habitat Units AAHU Gain = Difference in AAHUs between existing AAHUs and AAHUs generated with implementation of the compensation increment

Table 6. Cost per Acre by Compensation Increment

Habitat Type	Increment 1			Increment 2			Increment 3		
	Total Compen-sation Cost	Compen-sation Objective (acres)	Cost per acre	Total Compen-sation Cost	Compen-sation Objective (acres)	Cost per acre	Total Compen-sation Cost	Compen-sation Objective (acres)	Cost per acre
Oak Woodland	$3,744,960	199.20	$18,800	$2,655,300	50.10	$53,000	$2,482,215	38.1	$65,150
Riparian Woodland	$1,116,720	59.40	$18,800	$307,400	5.80	$53,000	$444,323	6.82	$65,150
Seasonal Wetland	$231,520	5.0	$46,304	$46,304	2.03	$99,200	$321,280	2.51	$128,000

Table 7. Cost of Average Annual Habitat Unit per Acre

Habitat Type	Increment 1			Increment 2			Increment 3		
	AAHU Gain (per acre)	Per Acre Cost	Cost per AAHU	AAHU Gain (per acre)	Per Acre Cost	Cost per AAHU	AAHU Gain (per acre)	Per Acre Cost	Cost per AAHU
Oak Woodland	0.17	$18,800	$110,588	0.67	$53,000	$79,104	0.89	$65,150	$73,202
Riparian Woodland	0.14	$18,800	$134,285	1.43	$53,000	$37,062	1.22	$65,150	$53,401
Seasonal Wetland	0.24	$46,304	$192,933	0.59	$99,200	$168,135	0.48	$128,000	$266,666

9.0 Incremental Cost Analysis

The mitigation increment outputs and cost information described above was used with the IWR-Plan software (version 3.3) to complete the cost effectiveness and incremental cost analysis. There were 3 cost effective combinations and 3 best buy combinations. The best buy plans are shown on Figure 1. The incremental cost of the best buy combinations are shown in Table 8.

Figure 1. Best Buy Plans

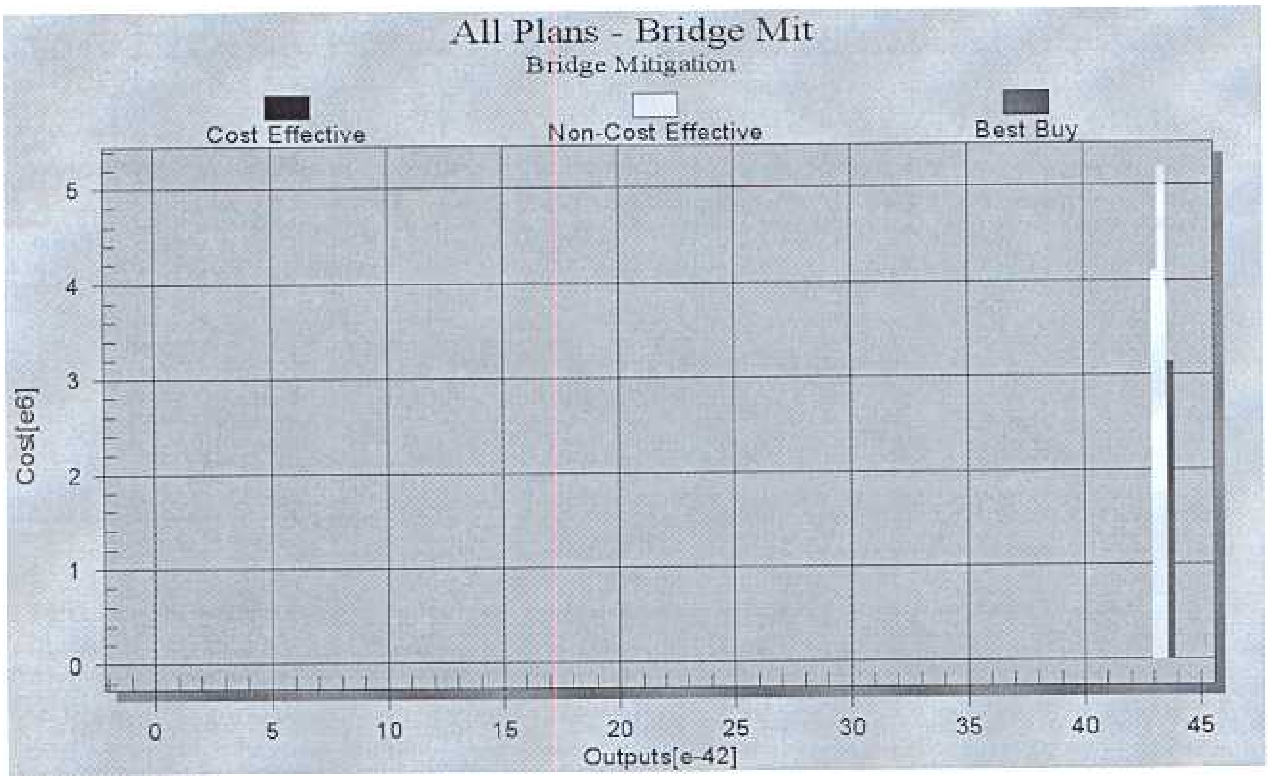

Table 8. Incremental Cost of Best Buy Plan Combinations

Plan	Total Outputs	Total Cost (dollars)	Incremental Cost (dollars)	Incremental Output (AAHU)	Incremental Cost per Output
A0 B0 C0*	00.0	0.00	0.00	0.00	0.00
A3 B2 C2*	43.40	$2,990,991	$2,990,991	43.4	$68,916.84
A3 B3 C2*	43.42	$3,127,914	$136,923	0.02	$6,846,150

* A=Oak Woodland, B=Riparian Woodland, C=Seasonal Wetland

10. Summary and Recommendations

The cost effectiveness and incremental analysis identified the combination of oak woodland increment 3, riparian woodland increment 2, and seasonal wetland increment 2 as the most cost effective increment for mitigation. This plan varies from the recommendations provided by FWS in the Draft CAR. We will work with FWS to implement mitigation plan that cost effective and fully mitigates for the project-related adverse effects

Appendix B –

Endangered, Threatened, and Candidate Species List

U.S. Fish & Wildlife Service

Sacramento Fish & Wildlife Office

Federal Endangered and Threatened Species that Occur in or may be Affected by Projects in the Counties and/or U.S.G.S. 7 1/2 Minute Quads you requested

Document Number: 120613030801

Database Last Updated: September 18, 2011

Quad Lists

Listed Species

Invertebrates

Branchinecta conservatio
Conservancy fairy shrimp (E)

Branchinecta lynchi
vernal pool fairy shrimp (T)

Desmocerus californicus dimorphus
valley elderberry longhorn beetle (T)

Lepidurus packardi
vernal pool tadpole shrimp (E)

Fish

Hypomesus transpacificus
delta smelt (T)

Oncorhynchus mykiss
Central Valley steelhead (T) (NMFS)
Critical habitat, Central Valley steelhead (X) (NMFS)

Oncorhynchus tshawytscha
Central Valley spring-run chinook salmon (T) (NMFS)
winter-run chinook salmon, Sacramento River (E) (NMFS)

Amphibians

Ambystoma californiense
California tiger salamander, central population (T)

Rana draytonii
California red-legged frog (T)

Reptiles

Thamnophis gigas
giant garter snake (T)

Plants

Calystegia stebbinsii
Stebbins's morning-glory (E)

Ceanothus roderickii
Pine Hill ceanothus (E)

Fremontodendron californicum ssp. decumbens
Pine Hill flannelbush (E)

Galium californicum ssp. sierrae

El Dorado bedstraw (E)

Orcuttia viscida

Critical habitat, Sacramento Orcutt grass (X)

Sacramento Orcutt grass (E)

Senecio layneae

Layne's butterweed (=ragwort) (T)

Quads Containing Listed, Proposed or Candidate Species:

CLARKSVILLE (511A)

FOLSOM (511B)

County Lists

No county species lists requested.

Key:

(E) *Endangered* - Listed as being in danger of extinction.

(T) *Threatened* - Listed as likely to become endangered within the foreseeable future.

(P) *Proposed* - Officially proposed in the Federal Register for listing as endangered or threatened.

(NMFS) Species under the Jurisdiction of the National Oceanic & Atmospheric Administration Fisheries Service. Consult with them directly about these species.

Critical Habitat - Area essential to the conservation of a species.

(PX) *Proposed Critical Habitat* - The species is already listed. Critical habitat is being proposed for it.

(C) *Candidate* - Candidate to become a proposed species.

(V) Vacated by a court order. Not currently in effect. Being reviewed by the Service.

(X) *Critical Habitat* designated for this species

Important Information About Your Species List

How We Make Species Lists

We store information about endangered and threatened species lists by U.S. Geological Survey 7½ minute quads. The United States is divided into these quads, which are about the size of San Francisco.

The animals on your species list are ones that occur within, **or may be affected by** projects within, the quads covered by the list.

- Fish and other aquatic species appear on your list if they are in the same watershed as your quad or if water use in your quad might affect them.
- Amphibians will be on the list for a quad or county if pesticides applied in that area may be carried to their habitat by air currents.
- Birds are shown regardless of whether they are resident or migratory. Relevant birds on the county list should be considered regardless of whether they appear on a quad list.

Plants

Any plants on your list are ones that have actually been observed in the area covered by the list. Plants may exist in an area without ever having been detected there. You can find out what's in the surrounding quads through the California Native Plant Society's online Inventory of Rare and Endangered Plants.

Surveying

Some of the species on your list may not be affected by your project. A trained biologist and/or botanist, familiar with the habitat requirements of the species on your list, should determine whether they or habitats suitable for them may be affected by your project. We recommend that your surveys include any proposed and candidate species on your list. See our Protocol and Recovery Permits pages.

For plant surveys, we recommend using the Guidelines for Conducting and Reporting Botanical Inventories. The results of your surveys should be published in any environmental documents prepared for your project.

Your Responsibilities Under the Endangered Species Act

All animals identified as listed above are fully protected under the Endangered Species Act of 1973, as amended. Section 9 of the Act and its implementing regulations prohibit the take of a federally listed wildlife species. Take is defined by the Act as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" any such animal.

> Take may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or shelter (50 CFR §17.3).

Take incidental to an otherwise lawful activity may be authorized by one of two procedures:

- If a Federal agency is involved with the permitting, funding, or carrying out of a project that may result in take, then that agency must engage in a formal consultation with the Service.

  During formal consultation, the Federal agency, the applicant and the Service work together to avoid or minimize the impact on listed species and their habitat. Such consultation would result in a biological opinion by the Service addressing the anticipated effect of the project on listed and proposed species. The opinion may authorize a limited level of incidental take.

- If no Federal agency is involved with the project, and federally listed species may be taken as part of the project, then you, the applicant, should apply for an incidental take permit. The Service may issue such a permit if you submit a satisfactory conservation plan for the species that would be affected by your project.

  Should your survey determine that federally listed or proposed species occur in the area and are likely to be affected by the project, we recommend that you work with this office and the California Department of Fish and Game to develop a plan that minimizes the project's direct and indirect impacts to listed species and compensates for project-related loss of habitat. You should include the plan in any environmental documents you file.

Critical Habitat

When a species is listed as endangered or threatened, areas of habitat considered essential to its conservation may be designated as critical habitat. These areas may require special management considerations or protection. They provide needed space for growth and normal behavior; food, water, air, light, other nutritional or physiological requirements; cover or shelter; and sites for breeding, reproduction, rearing of offspring, germination or seed dispersal.

Although critical habitat may be designated on private or State lands, activities on these lands are not restricted unless there is Federal involvement in the activities or direct harm to listed wildlife.

If any species has proposed or designated critical habitat within a quad, there will be a separate line for this on the species list. Boundary descriptions of the critical habitat may be found in the Federal Register. The information is also reprinted in the Code of Federal Regulations (50 CFR 17.95). See our Map Room page.

Candidate Species

We recommend that you address impacts to candidate species. We put plants and animals on our candidate list when we have enough scientific information to eventually propose them for listing as threatened or endangered. By considering these species early in your planning process you may be able to avoid the problems that could develop if one of these candidates was listed before the end of your project.

Species of Concern

The Sacramento Fish & Wildlife Office no longer maintains a list of species of concern. However, various other agencies and organizations maintain lists of at-risk species. These lists provide essential information for land management planning and conservation efforts. More info

Wetlands

If your project will impact wetlands, riparian habitat, or other jurisdictional waters as defined by section 404 of the Clean Water Act and/or section 10 of the Rivers and Harbors Act, you will need to obtain a permit from the U.S. Army Corps of Engineers. Impacts to wetland habitats require site specific mitigation and monitoring. For questions regarding wetlands, please contact Mark Littlefield of this office at (916) 414-6520.

Updates

Our database is constantly updated as species are proposed, listed and delisted. If you address proposed and candidate species in your planning, this should not be a problem. However, we recommend that you get an updated list every 90 days. That would be September 11, 2012.

Selected Elements by Scientific Name

California Department of Fish and Game

California Natural Diversity Database

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFG SSC or FP
Accipiter cooperii Cooper's hawk	ABNKC12040	None	None	G5	S3	WL
Agelaius tricolor tricolored blackbird	ABPBXB0020	None	None	G2G3	S2	SSC
Andrena blennospermatis Blennosperma vernal pool andrenid bee	IIHYM35030	None	None	G2	S2	
Antrozous pallidus pallid bat	AMACC10010	None	None	G5	S3	SSC
Ardea alba great egret	ABNGA04040	None	None	G5	S4	
Ardea herodias great blue heron	ABNGA04010	None	None	G5	S4	
Athene cunicularia burrowing owl	ABNSB10010	None	None	G4	S2	SSC
Branchinecta lynchi vernal pool fairy shrimp	ICBRA03030	Threatened	None	G3	S2S3	
Ceanothus roderickii Pine Hill ceanothus	PDRHA04190	Endangered	Rare	G1	S1	1B.2
Chlorogalum grandiflorum Red Hills soaproot	PMLIL0G020	None	None	G3	S3	1B.2
Clarkia biloba ssp. brandegeeae Brandegee's clarkia	PDONA05053	None	None	G4G5T3	S3	1B.2
Desmocerus californicus dimorphus valley elderberry longhorn beetle	IICOL48011	Threatened	None	G3T2	S2	
Downingia pusilla dwarf downingia	PDCAM060C0	None	None	G2	S2	2.2
Elanus leucurus white-tailed kite	ABNKC06010	None	None	G5	S3	FP
Emys marmorata western pond turtle	ARAAD02030	None	None	G3G4	S3	SSC
Falco columbarius merlin	ABNKD06030	None	None	G5	S3	WL
Fremontodendron decumbens Pine Hill flannelbush	PDSTE03030	Endangered	Rare	G1	S1	1B.2
Galium californicum ssp. sierrae El Dorado bedstraw	PDRUB0N0E7	Endangered	Rare	G5T1	S1	1B.2
Haliaeetus leucocephalus bald eagle	ABNKC10010	Delisted	Endangered	G5	S2	FP
Helianthemum suffrutescens Bisbee Peak rush-rose	PDCIS020F0	None	None	G2Q	S2.2	3.2
Hydrochara rickseckeri Ricksecker's water scavenger beetle	IICOL5V010	None	None	G1G2	S1S2	

Species	Element Code	Federal Status	State Status	Global Rank	State Rank	Rare Plant Rank/CDFG SSC or FP
Lasionycteris noctivagans silver-haired bat	AMACC02010	None	None	G5	S3S4	
Linderiella occidentalis California linderiella	ICBRA06010	None	None	G3	S2S3	
Navarretia myersii ssp. myersii pincushion navarretia	PDPLM0C0X1	None	None	G1T1	S1.1	1B.1
Northern Hardpan Vernal Pool Northern Hardpan Vernal Pool	CTT44110CA	None	None	G3	S3.1	
Northern Volcanic Mud Flow Vernal Pool Northern Volcanic Mud Flow Vernal Pool	CTT44132CA	None	None	G1	S1.1	
Orcuttia viscida Sacramento Orcutt grass	PMPOA4G070	Endangered	Endangered	G1	S1	1B.1
Packera layneae Layne's ragwort	PDAST8H1V0	Threatened	Rare	G2	S2	1B.2
Phalacrocorax auritus double-crested cormorant	ABNFD01020	None	None	G5	S3	WL
Rana draytonii California red-legged frog	AAABH01022	Threatened	None	G4T2T3	S2S3	SSC
Sagittaria sanfordii Sanford's arrowhead	PMALI040Q0	None	None	G3	S3	1B.2
Spea hammondii western spadefoot	AAABF02020	None	None	G3	S3	SSC
Valley Needlegrass Grassland Valley Needlegrass Grassland	CTT42110CA	None	None	G3	S3.1	
Wyethia reticulata El Dorado County mule ears	PDAST9X0D0	None	None	G2	S2	1B.2

Record Count: 34

Appendix C –

National and California Ambient Air Quality Standards

National and California Ambient Air Quality Standards.

Pollutant	Averaging Time	National Primary Standard[a]	California Standard[b]	Violation Criteria	
				National	California
CO	8 Hour	9 ppm	9 ppm	Not to be exceeded more than once per year	If exceeded
	1 Hour	35 ppm	20 ppm	Not to be exceeded more than once per year	If exceeded
	8 Hour (Lake Tahoe)	NA	6 ppm	NA	If exceeded
NO_2	Annual	0.053 ppm	0.030 ppm	If exceeded	If exceeded
	1 Hour	0.100 ppm	0.18 ppm	The 3-year average of 98th percentile of the daily maximum 1-hour average must not exceed	If exceeded
O_3	8 Hour (2008 standard)	0.075 ppm	0.070 ppm	The 3-year average of 4th-highest daily maximum 8-hour average must not exceed	If exceeded
	1 Hour	NA	0.09 ppm	NA	If exceeded
PM_{10}	Annual	NA	20 µg/m3	NA	If exceeded
	24 Hour	150 µg/m3	50 µg/m3	Not to be exceeded more than once per year on average over 3 years	If exceeded
$PM_{2.5}$	Annual	15.0 µg/m3	12 µg/m3	The 3-year average of the weighted annual mean must not exceed	If exceeded
	24 Hour	35 µg/m3	NA	The 3-year average of 98th percentile of the 24-hour concentration must not exceed	NA
SO_2	Annual	0.03 ppm	NA	If exceeded	NA
	24 Hour	0.14 ppm	0.04 ppm	Not to be exceeded more than once per year	If exceeded
	3 Hour	NA[c]	NA	NA	NA
	1 Hour	NA	0.25 ppm	NA	If exceeded

[a] 40 CFR 50.4 through 50.13
[b] California Code of Regulations, Table of Standards, Section 70200 of Title 17
[c] No National Primary 3 hour Standard for SO2. National Secondary 3hour standard for SO2 is 0.5 ppm
µg/m3 micrograms per cubic meter
ppm parts per million

Appendix D –

Air Quality Analysis

Road Construction Emissions Model, Version 6.3.2

Emission Estimates for -> JFP Downstream Features **Project Phases (English Units)**	**ROG (lbs/day)**	**CO (lbs/day)**	**NOx (lbs/day)**	**Total PM10 (lbs/day)**	**Exhaust PM10 (lbs/day)**	**Fugitive Dust PM10 (lbs/day)**	**Total PM2.5 (lbs/day)**	**Exhaust PM2.5 (lbs/day)**	**Fugitive Dust PM2.5 (lbs/day)**	**CO2 (lbs/day)**
Grubbing/Land Clearing	3.2	14.1	28.1	3.1	1.1	2.0	1.5	1.0	0.4	3,162.4
Grading/Excavation	5.2	35.9	39.3	3.8	1.8	2.0	2.0	1.6	0.4	5,244.2
Drainage/Utilities/Sub-Grade	3.2	13.9	25.5	3.3	1.3	2.0	1.6	1.2	0.4	2,933.2
Paving	1.9	7.9	11.4	1.0	1.0	-	0.9	0.9	-	1,152.7
Maximum (pounds/day)	5.2	35.9	39.3	3.8	1.8	2.0	2.0	1.6	0.4	5,244.2
Total (tons/construction project)	0.2	1.1	1.4	0.1	0.1	0.1	0.1	0.1	0.0	175.8

Notes: Project Start Year -> 2013

Project Length (months) -> 4

Total Project Area (acres) -> 11

Maximum Area Disturbed/Day (acres) -> 0

Total Soil Imported/Exported (yd^3/day)-> 363

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sum of exhaust and fugitive dust emissions shown in columns K and L.

Emission Estimates for -> JFP Downstream Features **Project Phases (Metric Units)**	**ROG (kgs/day)**	**CO (kgs/day)**	**NOx (kgs/day)**	**Total PM10 (kgs/day)**	**Exhaust PM10 (kgs/day)**	**Fugitive Dust PM10 (kgs/day)**	**Total PM2.5 (kgs/day)**	**Exhaust PM2.5 (kgs/day)**	**Fugitive Dust PM2.5 (kgs/day)**	**CO2 (kgs/day)**
Grubbing/Land Clearing	1.5	6.4	12.8	1.4	0.5	0.9	0.7	0.5	0.2	1,437.5
Grading/Excavation	2.4	16.3	17.9	1.7	0.8	0.9	0.9	0.7	0.2	2,383.7
Drainage/Utilities/Sub-Grade	1.5	6.3	11.6	1.5	0.6	0.9	0.7	0.5	0.2	1,333.3
Paving	0.9	3.6	5.2	0.5	0.5	-	0.4	0.4	-	523.9
Maximum (kilograms/day)	2.4	16.3	17.9	1.7	0.8	0.9	0.9	0.7	0.2	2,383.7
Total (megagrams/construction project)	0.2	1.0	1.3	0.1	0.1	0.1	0.1	0.1	0.0	159.5

Notes: Project Start Year -> 2013

Project Length (months) -> 4

Total Project Area (hectares) -> 4

Maximum Area Disturbed/Day (hectares) -> 0

Total Soil Imported/Exported ($meters^3$/day)-> 278

PM10 and PM2.5 estimates assume 50% control of fugitive dust from watering and associated dust control measures if a minimum number of water trucks are specified.

Total PM10 emissions shown in column F are the sum of exhaust and fugitive dust emissions shown in columns H and I. Total PM2.5 emissions shown in Column J are the sume of exhaust and fugitive dust emissions shown in columns K and L.

Road Construction Emissions Model Version 6.3.2

Data Entry Worksheet

SACRAMENTO METROPOLITAN AIR QUALITY MANAGEMENT DISTRICT

Note: Required data input sections have a yellow background.
Optional data input sections have a blue background. Only areas with a yellow or blue background can be modified. Program defaults have a white background.
The user is required to enter information in cells C10 through C25.

To begin a new project, click this button to clear data previously entered. This button will only work if you opted not to disable macros when loading this spreadsheet.

Input Type		
Project Name	JFP Downstream Features	
Construction Start Year	2013	Enter a Year between 2005 and 2025 (inclusive)
Project Type	1	1 New Road Construction 2 Road Widening 3 Bridge/Overpass Construction
Project Construction Time	4.0	months
Predominant Soil/Site Type: Enter 1, 2, or 3	2	1. Sand Gravel 2. Weathered Rock-Earth 3. Blasted Rock
Project Length	0.3	miles
Total Project Area	11.0	acres
Maximum Area Disturbed/Day	0.2	acres
Water Trucks Used?	1	1. Yes 2. No
Soil Imported	363.0	yd^3/day
Soil Exported	0.0	yd^3/day
Average Truck Capacity	20.0	yd^3 (assume 20 if unknown)

The remaining sections of this sheet contain areas that can be modified by the user, although those modifications are optional.

Note: The program's estimates of construction period phase length can be overridden in cells C34 through C37.

Construction Periods	User Override of Construction Months	Program Calculated Months	2005	%	2006	%	2007	%
Grubbing/Land Clearing	0.15	0.40	0.00	0.00	0.00	0.00	0.00	0.00
Grading/Excavation	2.00	1.80	0.00	0.00	0.00	0.00	0.00	0.00
Drainage/Utilities/Sub-Grade	1.45	1.20	0.00	0.00	0.00	0.00	0.00	0.00
Paving	0.40	0.60	0.00	0.00	0.00	0.00	0.00	0.00
Totals	4.00	4.00						

Hauling emission default values can be overridden in cells C45 through C46.

Soil Hauling Emissions **User Input**	User Override of Soil Hauling Defaults	Default Values				
Miles/round trip	5.00	30				
Round trips/day	80.00	18				
Vehicle miles traveled/day (calculated)			400			
Hauling Emissions	**ROG**	**NOx**	**CO**	**PM10**	**PM2.5**	**CO2**

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate (grams/trip)	10.32	7.57	172.85	0.01	0.01	199.87
Pounds per day	1.6	9.6	18.6	0.4	0.3	1667.8
Tons per contruction period	0.03	0.21	0.41	0.01	0.01	36.69

Worker commute default values can be overridden in cells C60 through C65.

Worker Commute Emissions

	User Override of Worker Commute Default Values	Default Values
Miles/ one-way trip		20
One-way trips/day		2
No. of employees: Grubbing/Land Clearing		3
No. of employees: Grading/Excavation		6
No. of employees: Drainage/Utilities/Sub-Grade		6
No. of employees: Paving		5

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.118	0.211	2.201	0.033	0.018	426.660
Emission rate - Grading/Excavation (grams/mile)	0.118	0.211	2.201	0.033	0.018	426.660
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.118	0.211	2.201	0.033	0.018	426.660
Emission rate - Paving (grams/mile)	0.118	0.211	2.201	0.033	0.018	426.660
Emission rate - Grubbing/Land Clearing (grams/trip)	0.746	0.316	7.305	0.130	0.013	192.690
Emission rate - Grading/Excavation (grams/trip)	0.746	0.316	7.305	0.130	0.013	192.690
Emission rate - Draining/Utilities/Sub-Grade (gr/trip)	0.746	0.316	7.305	0.130	0.013	192.690
Emission rate - Paving (grams/trip)	0.746	0.316	7.305	0.130	0.013	192.690
Pounds per day - Grubbing/Land Clearing	0.055	0.069	0.839	0.013	0.006	127.689
Tons per const. Period - Grub/Land Clear	0.000	0.000	0.001	0.000	0.000	0.211
Pounds per day - Grading/Excavation	0.055	0.069	0.839	0.013	0.006	127.689
Tons per const. Period - Grading/Excavation	0.001	0.002	0.018	0.000	0.000	2.809
Pounds per day - Drainage/Utilities/Sub-Grade	0.055	0.069	0.839	0.013	0.006	127.689
Tons per const. Period - Drain/Util/Sub-Grade	0.001	0.001	0.013	0.000	0.000	2.037
Pounds per day - Paving	0.068	0.069	0.839	0.013	0.006	174.678
Tons per const. Period - Paving	0.000	0.000	0.004	0.000	0.000	0.769
tons per construction period	0.002	0.003	0.037	0.001	0.000	5.825

Water truck default values can be overriden in cells C91 through C93 and E91 through E93.

Water Truck Emissions

	User Override of Default # Water Trucks	Program Estimate of Number of Water Trucks	User Override of Truck Miles Traveled/Day	Default Values Miles Traveled/Day
Grubbing/Land Clearing - Exhaust		1		40
Grading/Excavation - Exhaust		1		40
Drainage/Utilities/Subgrade		1		40

	ROG	NOx	CO	PM10	PM2.5	CO2
Emission rate - Grubbing/Land Clearing (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate - Grading/Excavation (grams/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Emission rate - Draining/Utilities/Sub-Grade (gr/mile)	0.84	10.25	5.45	0.40	0.33	1874.76
Pounds per day - Grubbing/Land Clearing	0.07	0.90	0.48	0.04	0.03	165.18
Tons per const. Period - Grub/Land Clear	0.00	0.02	0.01	0.00	0.00	3.63
Pound per day - Grading/Excavation	0.07	0.90	0.48	0.04	0.03	165.18
Tons per const. Period - Grading/Excavation	0.00	0.02	0.01	0.00	0.00	3.63

Pound per day - Drainage/Utilities/Subgrade	0.07	0.90	0.48	0.04	0.03	165.18
Tons per const. Period - Drainage/Utilities/Subgrade	0.00	0.01	0.01	0.00	0.00	2.63

Fugitive dust default values can be overridden in cells C110 through C112.

Fugitive Dust	User Override of Max Acreage Disturbed/Day	Default Maximum Acreage/Day	PM10 pounds/day	PM10 tons/per period	PM2.5 pounds/day	PM2.5 tons/per period
Fugitive Dust - Grubbing/Land Clearing		0.2	2.0	0.0	0.4	0.0
Fugitive Dust - Grading/Excavation		0.2	2.0	0.0	0.4	0.0
Fugitive Dust - Drainage/Utilities/Subgrade		0.2	2.0	0.0	0.4	0.0

Off-Road Equipment Emissions

Grubbing/Land Clearing Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
	1	Rubber Tired Dozers	1.51	6.67	12.84	0.53	0.49	1245.79
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
	1	Scrapers	1.61	6.11	14.29	0.55	0.51	1623.76
0.00	1	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grubbing/Land Clearing	pounds per day	3.1	12.8	27.1	1.1	1.0	2869.5
	Grubbing/Land Clearing	tons per phase	0.0	0.0	0.0	0.0	0.0	4.7

Grading/Excavation Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00

		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
	0	Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	1	Excavators	0.59	3.25	4.37	0.25	0.23	547.36
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
	1	Graders	0.77	3.84	5.86	0.33	0.30	647.87
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
	0	Other Construction Equipment	0.01	0.04	0.05	0.00	0.00	5.76
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
	1	Rubber Tired Loaders	0.54	2.71	4.11	0.23	0.21	458.86
	1	Scrapers	1.61	6.11	14.29	0.55	0.51	1623.76
0.00	1	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Grading/Excavation	pounds per day	3.5	15.9	28.7	1.4	1.3	3283.6
	Grading	tons per phase	0.1	0.4	0.6	0.0	0.0	72.2

Drainage/Utilities/Subgrade Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*		ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
	1	Graders	0.77	3.84	5.86	0.33	0.30	647.87
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00

		Pavers	0.00	0.00	0.00	0.00	0.00	0.00
		Paving Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	1	Plate Compactors	0.02	0.09	0.11	0.00	0.00	14.83
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
		Rollers	0.00	0.00	0.00	0.00	0.00	0.00
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
	1	Scrapers	1.61	6.11	14.29	0.55	0.51	1623.76
0.00	1	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
	1	Trenchers	0.70	2.55	4.29	0.37	0.34	353.84
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Drainage	pounds per day	3.1	12.6	24.6	1.3	1.2	2640.3
	Drainage	tons per phase	0.0	0.2	0.4	0.0	0.0	42.1

Paving Override of Default Number of Vehicles	Default Number of Vehicles *Program-estimate*	Type	ROG pounds/day	CO pounds/day	NOx pounds/day	PM10 pounds/day	PM2.5 pounds/day	CO2 pounds/day
		Aerial Lifts	0.00	0.00	0.00	0.00	0.00	0.00
		Air Compressors	0.00	0.00	0.00	0.00	0.00	0.00
		Bore/Drill Rigs	0.00	0.00	0.00	0.00	0.00	0.00
		Cement and Mortar Mixers	0.00	0.00	0.00	0.00	0.00	0.00
		Concrete/Industrial Saws	0.00	0.00	0.00	0.00	0.00	0.00
		Cranes	0.00	0.00	0.00	0.00	0.00	0.00
		Crushing/Proc. Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Excavators	0.00	0.00	0.00	0.00	0.00	0.00
		Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Generator Sets	0.00	0.00	0.00	0.00	0.00	0.00
		Graders	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Tractors	0.00	0.00	0.00	0.00	0.00	0.00
		Off-Highway Trucks	0.00	0.00	0.00	0.00	0.00	0.00
		Other Construction Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other General Industrial Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Other Material Handling Equipment	0.00	0.00	0.00	0.00	0.00	0.00
	1	Pavers	0.78	2.82	4.67	0.41	0.38	386.18
	1	Paving Equipment	0.58	2.12	3.52	0.31	0.28	291.96
		Plate Compactors	0.00	0.00	0.00	0.00	0.00	0.00
		Pressure Washers	0.00	0.00	0.00	0.00	0.00	0.00
		Pumps	0.00	0.00	0.00	0.00	0.00	0.00
	1	Rollers	0.50	2.07	3.18	0.27	0.25	299.86
		Rough Terrain Forklifts	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Dozers	0.00	0.00	0.00	0.00	0.00	0.00
		Rubber Tired Loaders	0.00	0.00	0.00	0.00	0.00	0.00
		Scrapers	0.00	0.00	0.00	0.00	0.00	0.00
0.00	1	Signal Boards	0.00	0.00	0.00	0.00	0.00	0.00
		Skid Steer Loaders	0.00	0.00	0.00	0.00	0.00	0.00

		Surfacing Equipment	0.00	0.00	0.00	0.00	0.00	0.00
		Sweepers/Scrubbers	0.00	0.00	0.00	0.00	0.00	0.00
		Tractors/Loaders/Backhoes	0.00	0.00	0.00	0.00	0.00	0.00
		Trenchers	0.00	0.00	0.00	0.00	0.00	0.00
		Welders	0.00	0.00	0.00	0.00	0.00	0.00
	Paving	pounds per day	1.9	7.0	11.4	1.0	0.9	978.0
	Paving	tons per phase	0.0	0.0	0.1	0.0	0.0	4.3
Total Emissions all Phases (tons per construction period) =>			0.1	0.6	1.1	0.1	0.1	123.4

Equipment default values for horsepower, load factor, and hours/day can be overridden in cells C285 through C317, E285 through E317, and G285 through G317.

Equipment		Default Values Horsepower		Default Values Load Factor		Default Values Hours/day
Aerial Lifts		60		0.46		8
Air Compressors		106		0.48		8
Bore/Drill Rigs		291		0.75		8
Cement and Mortar Mixers		10		0.56		8
Concrete/Industrial Saws		19		0.73		8
Cranes		399		0.43		8
Crushing/Proc. Equipment		142		0.78		8
Excavators		168		0.57		8
Forklifts		145		0.30		8
Generator Sets		549		0.74		8
Graders		174		0.61		8
Off-Highway Tractors		267		0.65		8
Off-Highway Trucks		479		0.57		8
Other Construction Equipment		75		0.62		8
Other General Industrial Equipment		238		0.51		8
Other Material Handling Equipment		191		0.59		8
Pavers		100		0.62		8
Paving Equipment		104		0.53		8
Plate Compactors		8		0.43		8
Pressure Washers		1		0.60		8
Pumps		53		0.74		8
Rollers		95		0.56		8
Rough Terrain Forklifts		93		0.60		8
Rubber Tired Dozers		357		0.59		8
Rubber Tired Loaders		157		0.54		8
Scrapers		313		0.72		8
Signal Boards		20		0.78		8
Skid Steer Loaders		44		0.55		8
Surfacing Equipment		362		0.45		8
Sweepers/Scrubbers		91		0.68		8
Tractors/Loaders/Backhoes		108		0.55		8
Trenchers		63		0.75		8
Welders		45		0.45		8

Appendix E –

Calculated Emission for Concrete Batch Plant

A-2. Air Quality Methodology and Assumptions

This appendix presents detailed emission calculation results and tables for the construction of the control structure and lining of the spillway chute and stilling basin, including all associated activities. The analysis consists of a quantitative evaluation of construction work that would be performed during the 2010 through 2016 time period. Dispersion modeling was not conducted because the graded area would not exceed 15 acres.

A.1 Methodology and Calculations

The construction emissions were estimated from several emission models and spreadsheet calculations, depending on the source type and data availability. Emission factors from the Folsom Dam Safety and Flood Damage Reduction Final EIS/EIR (Reclamation 2007) or Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009) were used whenever possible. Project emissions were estimated from appropriate emission factors, features being worked, and associated schedules. The following construction sources and activities were analyzed for emissions:

- On-site construction equipment and construction truck engine emissions (all pollutants).
- On-site and off-site haul truck engine emissions (all criteria pollutants and carbon dioxide).
- Off-site worker vehicle trips to and from the site.
- On-site and off-site haul truck fugitive dust emissions for paved and unpaved road travel.
- On-site material storage piles.
- On-site concrete batch plants.
- On-site demolition and grading (cut/fill for control structure) fugitive dust.
- On-site blasting emissions.

Spreadsheets showing each of the calculations are included in this appendix.

A.1.1 EXHAUST EMISSIONS

Diesel- and gasoline-powered vehicles and construction equipment would emit the criteria pollutants carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and particulate matter (PM) during all construction activities. This section describes the exhaust emission calculations.

A.1.1.1 On-site Construction equipment and truck engine emissions.

This EA used emission factors from The Folsom Dam Safety and Flood Damage Reduction Final EIS/EIR (Reclamation 2007). That study calculated on-site construction equipment and truck engine emissions based on the El Dorado Air Pollution Control District's (APCD) Guide to Air Quality (El Dorado, 2002).

The construction equipment emission rates are shown in Table A2-1. For this analysis, it was assumed that the emission factors for 2011 through 2016 were equal to those in 2010 and that the emission factors were based on an 8-hour work day.

The horsepower (hp) of the drilling rigs for this construction project was assumed to be 140 hp, which was less than the assumed horsepower used for the emission estimations in the Folsom Dam Safety and Flood Damage Reduction Final EIS/EIR. Therefore, emission factors from the Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009) were used for the bore/drill rigs in this EA. To be conservative, the emission factors for a 175 hp drill rig were used for calculations.

Table A2-1 . Construction Equipment Emission Factor (pounds per day) for 2009 - 2016.

	Emission Rate in Pounds Per Day			
Equipment Type	**ROG/VOC**	**CO**	**NO_x**	**PM_{10}**
Bore/Drill Rigs (Reclamation, 2007)				
2009	2.38	20.21	16.41	0.38
2010-2016	2.26	19.23	15.61	0.36
Bore/Drill Rigs (Corps, 2009)				
175 hp	0.966	6.033	9.19	0.469
	(54.76 g/hr)	(342.09 g/hr)	(521.05 g/hr)	26.59 g/hr)
Paving Equipment				
2009	1.04	8.23	6.78	0.22
2010-2016	1.04	8.52	6.39	0.19
Rollers				
2009	0.86	7.34	5.01	0.14
2010-2016	0.86	7.34	5.01	0.14
Cranes				
2009	1.44	12.27	8.37	0.23
2010-2016	1.44	12.27	8.37	0.23
Crawler Tractors				
2009	1.45	11.55	9.5	0.31
2010-2016	1.45	11.95	8.96	0.27
Crushing/Proc Equipment				
2009	2.12	16.86	13.88	0.45
2010-2016	2.12	17.45	13.09	0.4
Rough Terrain Forklifts				

2009	0.79	6.7	4.57	0.13
2010-2016	0.79	6.7	4.57	0.13
Rubber Tired Dozers				
2009	3.66	29.13	23.97	0.78
2010-2016	3.66	30.14	22.61	0.68
Rubber Tired Loaders				
2009	1.35	11.52	7.86	0.22
2010-2016	1.35	11.52	7.86	0.22
Excavators				
2009	1.84	15.64	10.67	0.29
2010-2016	1.84	15.64	10.67	0.29
Graders				
2009	1.76	14.98	10.22	0.28
2010-2016	1.76	14.98	10.22	0.28
Off-Highway Tractors/Compactors				
2009	1.84	14.65	12.05	0.39
2010-2016	1.84	15.16	11.37	0.34
Scrapers				
2009	3.64	30.96	21.12	0.58
2010-2016	3.64	30.96	21.12	0.58
Skid Steer Loaders				
2009	0.56	4.78	3.26	0.09
2010-2016	0.56	4.78	3.26	0.09
Off-Highway Trucks/Water Trucks				
2009	3.6	30.62	20.89	0.58
2010-2016	3.6	30.62	20.89	0.58
Other Construction Equipment				
2009	2.08	16.54	13.61	0.44
2010-2016	2.08	17.11	12.84	0.39
Pavers				
2009	1.37	11.62	7.93	0.22
2010-2016	1.37	11.62	7.93	0.22
Surfacing Equipment				
2009	3.77	29.99	24.68	0.8
2010-2016	3.77	31.03	23.28	0.7
Tractors/Loaders/Backhoes				
2009	0.65	5.18	4.26	0.14
2010-2016	0.65	5.36	4.02	0.12
Trenchers				
2009	1.00	8.53	5.82	0.16
2010-2016	1.00	8.53	5.82	0.16

ROG Reactive Organic Gas

VOC Volatile Organic Compound

A.1.1.2 On-site and off-site haul truck engine emissions.

This EA used emission factors from The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). That study used data from EMFAC2007 to calculate emission factors in grams per mile for criteria pollutants and for carbon dioxide for 2009 heavy-heavy duty diesel trucks in Sacramento County. The emission factors were based on the EMFAC mode with a speed of 15 mph. Mitigation reductions for NO_x and PM based on the Sacramento Metropolitan Air Quality Management District (SMAQMD) guidance was used for on-site haul trucks.

A.1.1.3 Off-site worker vehicle trips engine emissions.

This EA used emission factors from The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). That study used data from EMFAC2007 to calculate emission factors in pounds per 1000 miles for criteria pollutants and for carbon dioxide for the commutes of workers. The calculations assumed a vehicle fleet mix of fifty percent light duty automobiles and fifty percent light duty trucks. The emission factors are shown in Table A2-2.

Table A2-2. Construction Equipment Emission Factor (pounds per 1000 mile).

	Emission Rate in Pounds Per 1000 Miles						
Vehicle Description	**CO**	**CO_2**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_x**	**ROG**
Light Duty Automobile (LDA)	8.87	832	0.756	0.0694	0.0393	0.00786	0.991
Light Duty Truck (LDT)	10.6	1020	1.22	0.0905	0.0566	0.0131	1.12
Average based on 50 percent LDA and 50 percent LDT	9.75	927	0.99	0.0800	0.0479	0.00959	1.06

A.1.2 FUGITIVE DUST EMISSIONS

Fugitive dust and PM emissions are produced during vehicle travel on paved and unpaved roads, during handling of stockpile material, cut and fill operations, blasting, and concrete batch plant operation.

A.1.2.1 Off-site haul truck and worker vehicle fugitive dust emissions for paved road travel.

This EA used emission factors calculated in The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). Paved road entrained fugitive dust emissions were estimated using the AP-42 13.2.1 emission factor (pounds per vehicle mile traveled) and the vehicle miles traveled. The emission factor was calculated based on the silt content of the road, the weight of the vehicle, and the number of days where precipitation was over 0.01 inches. The vehicles were assumed to travel on five different types of paved roads: freeway, arterial (major street/highway), collector road, local road surface and rural road surface. The off-site truck haul trucks were assumed to be heavy-heavy duty diesel trucks with an average weight of 23.5 tons. The worker fleet was assumed to be 50 percent light duty automobiles and 50 percent light duty trucks with an average weight of 1.75 tons.

A.1.2.2 On-site haul truck fugitive dust emissions for unpaved road travel.

This EA used emission factors calculated in The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). Unpaved road entrained fugitive dust emissions were estimated using the AP-42 13.2.2 emission factor (pounds per vehicle mile traveled) and the vehicle miles traveled. The emission factor was calculated based on the silt content of the road, the weight of the vehicle, and the number of days where precipitation was over 0.01 inches. Fugitive dust from unpaved roads during hauling of excavated material from the control structure area to the MIAD would be the primary emission source. These emissions would be produced during the nine months of excavation.

A.1.2.3 On-site material storage pile handling.

This EA used assumptions and emission factors that were calculated in The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). Stockpile handling fugitive dust emissions were estimated using the AP-42 13.2.4 emission factor (pounds per ton) and the amount of material handled. The emission factor was based on the mean wind speed and material moisture content. Mitigation reductions from watering controls would contribute to a 90 percent emission control efficiency compared to the unmitigated emissions.

A.1.2.4 On-site material storage pile wind erosion.

This EA used assumptions and emission factors that were calculated in The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). Stockpile wind erosion fugitive dust emissions were estimated using the AP-42 13.2.5 emission factor (grams per square meter of exposed area) and the area exposed to wind. The emission factor was based on the fastest mile wind speed and the number of disturbances of the storage pile. It was assumed that material would be added to the pile each day and therefore the number of disturbances to the storage pile would be equal to the number of working days per year. For the storage pile of excavated material, this would be equal to the number of workdays during the nine months of excavation, or 180 working days. For the storage pile of aggregate material (for the concrete batch plants) this would be equal to the number of workdays per year, or 240 working days.

A.1.2.5 On-site concrete batch plants.

This EA used methodology and assumptions from AP-42 11.12. The emission factors for concrete batching calculate pounds of PM_{10} per ton of mixed concrete. The emission factors are shown in Table A2-3.

Table A2-3. Concrete Batching Emission Factor (pounds of PM_{10} per ton of concrete).

Batch Plant Source	Uncontrolled	Controlled

Aggregate transfer	0.0033	ND
Sand transfer	0.00099	ND
Cement unloading to elevated storage silo (pneumatic)	0.46	0.00034
Cement supplement unloading to elevated storage silo (pneumatic)	1.10	0.0049
Weigh hopper loading	0.0024	ND
Mixer loading (central mix)	0.134	0.0048
Truck loading (truck mix)	0.278	0.016
Total	1.98	0.033

ND = No data

Mitigation reductions from watering controls would contribute to a 90 percent emission control efficiency compared to the unmitigated emissions.

A.1.2.6 On-site demolition and grading (cut and fill).

Similar to calculations in The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009), this EA used the URBEMIS2007 model to calculate cut and fill fugitive dust emissions. The URBEMIS2007 model calculated fugitive dust emission based on the maximum daily volume disturbed. The daily volume disturbed was assumed to be 1,778 cubic yards per day based on the total volume to be excavated and the construction period.

A.1.2.7 On-site blasting emissions.

This EA used assumptions and emission factors that were calculated in The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). Blasting emissions were estimated using the methodology in the 2005 Blue Rock Quarry Draft Environmental Impact Report and were based on a blasting emission factor and the number of blasts per year. The calculation of the blasting emission factor depended on the blast area, blast depth, and moisture content. The mitigation control efficiency for PM_{10} was assumed to be 36 percent (Corps 2009).

A.1.3 GREEN HOUSE GAS (GHG) EMISSIONS

The principal greenhouse gases are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), sulfur hexafluoride (SF_6), perfluorocarbons (PFC), hydrofluorocarbons (HFC), and water vapor. Carbon dioxide is produced during the burning of fossil fuels and is the predominant greenhouse gas created during this project. Because no major sources exist for the other greenhouse gases during the construction process, they are not considered to be significant and no quantitative emission calculations were made for them.

A.1.3.1 On-site Construction equipment and truck engine emissions.

This EA used CO_2 emission factors (grams per hour) from The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). That study used data from SMAQMD published off-road emission factors for 2009, which defined emission factors for different types and sizes of construction equipment. The Corps calculated CO_2

emissions by multiplying the emission factor by the number of hours each equipment type was estimated to operate.

A.1.3.2 On-site and off-site haul truck engine emissions.

This EA used CO_2 emission factors from The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). That study used data from EMFAC2007 to calculate emission factors for carbon dioxide for 2009 heavy-heavy duty diesel trucks in Sacramento County. The emission factors were based on the EMFAC mode with a speed of 15 mph.

A.1.3.3 Off-site worker vehicle trips engine emissions.

This EA used emission factors from The Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009). That study used data from EMFAC2007 to calculate emission factors for carbon dioxide for the commutes of workers. The calculations assumed a vehicle fleet mix of fifty percent light duty automobiles and fifty percent light duty trucks. The emission factor for CO_2 is shown in Table A2-2 along with the emission factors for criteria pollutants.

A.1.3.4 Concrete batch plants.

The manufacture of concrete requires large amounts of energy to produce and results in substantial GHG emissions. Calculating these emissions would be more indicative of a "life-cycle" emissions analysis and can go beyond a typical EA analysis. However, the Corps estimated CO_2 emissions from the production of concrete during this project based on published emission factors. Studies have shown that CO_2 emissions generated by typical normal strength concrete mixes were found to range between 0.29 and 0.32 metric tons of CO_2 equivalent per cubic meter of concrete (Flowers and Sanjayan, 2007). In order to be conservative, this study assumed 0.32 metric tons (320 kilograms) of CO_2 would be created per cubic meter of concrete produced.

References:

El Dorado County Air Pollution Control District, February 2002. Guide to Air Quality Assessment.

Flowers and Sanjayan, 2007 (Abstract): "Green House Gas Emissions Due to Concrete Manufacture, The International Journal of Life Cycle Assessment. Vol 12, Number 5, July 2007. Landsberg, Germany: Ecomed.

Emissions - Cumulative Summary from all Activities

Exhaust Criteria Pollutants

Borings for Approach Channel Cofferdam

(Oct 2010 through Jan 2011)
Period of Operation (months) 4

Worker Commute Emissions

Unmitigated

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Pounds	187.20	17,798.00	19.01	1.54	0.92	0.18	20.35
Tons	0.094	8.90	0.010	0.00077	0.00046	0.000090	0.010

Mitigated (No mitigations)

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Pounds	187.20	17,798.00	19.01	1.54	0.92	0.18	20.35
Tons	0.094	8.90	0.010	0.00077	0.00046	0.000090	0.010

Construction Equipment Exhaust

Unmitigated

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Average annual tons	0.14		0.58	0.016	0.016		0.042
Total annual average tons	0.23		0.59	0.017	0.016		0.052

Mitigated (Enhanced Control Practices)
20% reduction in NO_x; 45% reduction in PM_{10}

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Average annual tons	0.14		0.46	0.0088	0.0088		0.042
Total annual average tons	0.23		0.47	0.010	0.0093		0.052

Control Structure

(Jan 2011 through July 2014)
Total Period of Operation (months) 42

Months of operation during Control Structure construction:

Excavation (months)	9	Gate installation (months)	9
Aggregate and concrete	24		

Worker Commute Emissions (Excavation, Concrete Placement, Gate Installation)

Unmitigated

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Total Pounds	14,332.50	1,362,690.00	1,455.30	117.60	70.41	14.10	1,558.20
Total Tons	7.17	681.35	0.73	0.059	0.035	0.0071	0.78
Average annual pounds	4,095.00	389,340.00	415.80	33.60	20.12	4.03	445.20
Average annual tons	2.05	194.67	0.21	0.017	0.010	0.0020	0.22

Mitigated (No mitigations)

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Total Pounds	14,332.50	1,362,690.00	1,455.30	117.60	70.41	14.10	1,558.20
Total Tons	7.17	681.35	0.73	0.059	0.035	0.0071	0.78
Average annual pounds	4,095.00	389,340.00	415.80	33.60	20.12	4.03	445.20
Average annual tons	2.05	194.67	0.21	0.017	0.010	0.0020	0.22

Construction Equipment Exhaust

Unmitigated

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Excavation - Average annual tons (Jan 2011 - Sept 2011; 9 months)	15.16		13.09	0.49	0.49		1.95
Concrete Placement - Average annual tons (July 2011 - July 2013; 24 months)	5.59		4.20	0.13	0.13		0.69
Gate Installation - Average annual tons (Dec 2013 - July 2014; 9 months)	1.23		0.84	0.023	0.023		0.14
Maximum Annual Cumulative - Avg. annual tons (During the year 2011: Excavation + 6 months concrete)	17.96		15.19	0.555	0.555		2.30

Mitigated (Enhanced Control Practices)
20% reduction in NO_x; 45% reduction in PM_{10}

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Excavation - Average annual tons (Jan 2011 - Sept 2011; 9 months)	15.16		10.47	0.27	0.27		1.95
Concrete Placement - Average annual tons (July 2011 - July 2013; 24 months)	5.59		3.36	0.072	0.072		0.69
Gate Installation - Average annual tons (Dec 2013 - July 2014; 9 months)	1.23		0.67	0.013	0.013		0.14
Maximum Annual Cumulative - Avg. annual tons (During the year 2011: Excavation + 6 months concrete)	17.96		12.15	0.305	0.305		2.30

On-Site Haul Truck

Unmitigated

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Average annual tons (2011)	0.35	53.25	0.43	0.025	0.022	0.00042	0.071

Mitigated (Enhanced Control Practices)

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Average annual tons (2011)	0.35	53.25	0.34	0.014	0.012	0.00042	0.071

Off-Site Haul Truck

Unmitigated

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Average annual tons	0.67	280.40	2.66	0.10	0.088	0.0020	0.18
Maximum Annual Cumulative - Avg. annual tons (During the year 2011)	21.02		18.49	0.70	0.68		2.77

Mitigated (No mitigations)

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Average annual tons	0.67	280.40	2.66	0.10	0.088	0.0020	0.18
Maximum Annual Cumulative - Avg. annual tons (During the year 2011)	21.02		15.36	0.44	0.42		2.77

Chute and Stilling Basin

(late 2013 through 2016)
Period of Operation (months) 36

Worker Commute Emissions

Unmitigated

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Total Pounds	12,285.00	1,168,020.00	1,247.40	100.80	60.35	12.08	1,335.60
Total Tons	6.14	584.01	0.62	0.050	0.030	0.0060	0.67
Average annual pounds	4,095.00	389,340.00	415.80	33.60	20.12	4.03	445.20
Average annual tons	2.05	194.67	0.21	0.017	0.010	0.0020	0.22

Mitigated (No mitigations)

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Total Pounds	12,285.00	1,168,020.00	1,247.40	100.80	60.35	12.08	1,335.60
Total Tons	6.14	584.01	0.62	0.050	0.030	0.0060	0.67
Average annual pounds	4,095.00	389,340.00	415.80	33.60	20.12	4.03	445.20
Average annual tons	2.05	194.67	0.21	0.017	0.010	0.0020	0.22

Construction Equipment Exhaust

Unmitigated

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Average annual tons	10.42		7.77	0.25	0.25		1.29

Mitigated (Enhanced Control Practices)

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Average annual tons	10.42		6.22	0.14	0.14		1.29

Off-Site Haul Truck

Unmitigated

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Average annual tons	0.79	332.44	3.16	0.12	0.10	0.0024	0.21
Total Annual Average Emissions	13.26		11.14	0.39	0.36		1.72
Maximum Annual Cumulative for Control Structure Gate Installation plus Chute and Stilling Basin - Avg. annual tons (During the year 2014: Chute and Stilling Basin annual average + 7 months of Gate Installation)	16.07		13.65	0.48	0.44		2.10

Mitigated (No mitigations)

	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Average annual tons	0.79	332.44	3.16	0.12	0.10	0.0024	0.21
Total Annual Average Emissions	13.26		9.58	0.27	0.25		1.72
Maximum Annual Cumulative for Control Structure Gate Installation plus Chute and Stilling Basin - Avg. annual tons (During the year 2014: Chute and Stilling Basin annual average + 7 months of Gate Installation)	16.07		11.93	0.36	0.32		2.10

Emissions - Construction Equipment Exhaust

Note: No CO_2 Calculations in this worksheet

Equipment

Type	Number	Hours per day	Days per week	Months		Hours per week	Hours per Project	Calculated 8-hour days per Project	Unmitigated Emissions (pounds) ROG	CO	NO_x	PM_{10}	Unmitigated Emissions (tons) ROG	CO	NO_x	PM_{10}		Unmitigated Estimated Annual Emissions (tons) ROG	CO	NO_x	PM_{10}
CONTROL STRUCTURE - Concrete Placement and Batch Plant (24 months)				July 2011 through July 2013																	
Semi-trailer truck	20	4	5	12		400	19,200	2,400	Off-site Haul Truck calculations									Off-site Haul Truck calculations			
Belly dump truck	8	4	3	16		96	6,144	768	Off-site Haul Truck calculations									Off-site Haul Truck calculations			
Tanker trucks	2	4	3	16		24	1,536	192	Off-site Haul Truck calculations									Off-site Haul Truck calculations			
Chiller	1	10	5	12		50	2,400	300	624	5,133	3,852	117	0.31	2.57	1.93	0.059		0.31	2.57	1.93	0.059
Stationary Cranes - electric	2	8	5	12		80	3,840	480	0	0	0	0	0	0	0	0		0	0	0	0
Forklifts	2	4	5	12		40	1,920	240	190	1,608	1,097	31.2	0.095	0.80	0.55	0.016		0.095	0.804	0.548	0.016
Man lift/scissor lift - electric	2	8	5	12		80	3,840	480	0	0	0	0	0	0	0	0		0	0	0	0
Water truck	1	4	5	12		20	960	120	53	266	324	19	0.03	0.13	0.16	0.009		0.027	0.133	0.16	0.009
Street sweeper	1	8	1	12		8	384	48	100	821	616	19	0.050	0.41	0.31	0.0094		0.050	0.411	0.31	0.0094
Jackhammers	2	8	1	12		16	768	96	200	1,643	1,233	37	0.10	0.82	0.62	0.019		0.100	0.821	0.62	0.019
Cement mixers (transit)	0	4	5	12		0	0	0	0	0	0	0	0.00	0.00	0.00	0.00		0.000	0.00	0.00	0.00
Front end loaders	2	8	5	8		80	2,560	320	208	1,715	1,286	38	0.10	0.86	0.64	0.019		0.104	0.858	0.643	0.019
Flatbed delivery truck	1		5						Off-site Haul Truck calculations									Off-site Haul Truck calculations			
Control Structure Concrete Placement Annual Average Emissions																		0.69	5.59	4.20	0.13
Control Structure Concrete Placement 2011 Annual Emissions (6 months)																	2011	0.34	2.80	2.10	0.07
Control Structure Concrete Placement 2012 Annual Emissions (12 months)																	2012	0.69	5.59	4.20	0.13
Control Structure Concrete Placement 2013 Annual Emissions (6 months)																	2013	0.34	2.80	2.10	0.07
CONTROL STRUCTURE - Excavation (9 months)			January 2011 through September 2011																		
"Super" dump trucks	5	8	5	6		200	4,800	600	On-site Haul Truck calculations									Off-site Haul Truck calculations			
Water trucks	1	4	5	6		20	480	60	27	133	162	9	0.013	0.07	0.08	0.005		0.013	0.07	0.08	0.005
Fuel truck	1	2	5	8		10	320	40	18	89	108	6	0.009	0.04	0.05	0.0031		0.009	0.04	0.05	0.003
Maintenance truck	4	4	5	8		80	2,560	320	142	709	863	50	0.07	0.35	0.43	0.025		0.07	0.35	0.43	0.025
Pickup trucks	10	4	5	8		200	6,400	800	54	509	59	4.3	0.027	0.25	0.029	0.0022		0.027	0.25	0.029	0.0022
Drills for grouting - electric	6	8	5	9		240	8,640	1,080	0	0	0	0	0.00	0.00	0.00	0.000		0.00	0.00	0.00	0.000
Rock drills for setting charges	NE	NE	NE	NE	NE	NE	7,353	919	888	5,545	8,447	431	0.44	2.77	4.22	0.216		0.44	2.77	4.22	0.216
Front end loaders	2	8	5	8		80	2,560	320	208	1,715	1,286	38	0.10	0.86	0.64	0.019		0.10	0.86	0.64	0.019
Dozers with rippers	2	8	5	8		80	2,560	320	464	3,824	2,867	86	0.23	1.91	1.43	0.043		0.23	1.91	1.43	0.043
Backhoes	4	8	5	8		160	5,120	640	416	3,430	2,573	77	0.21	1.72	1.29	0.038		0.21	1.72	1.29	0.038
Graders	2	8	5	8		80	2,560	320	563	4,794	3,270	90	0.28	2.40	1.64	0.045		0.28	2.40	1.64	0.045
Scrapers	3	8	5	3		120	1,440	180	655	5,573	3,802	104	0.33	2.79	1.90	0.052		0.33	2.79	1.90	0.052
Excavators	2	8	5	5		80	1,600	200	368	3,128	2,134	58	0.18	1.56	1.07	0.029		0.18	1.56	1.07	0.029
Compactor sheep foot	2	8	5	3		80	960	120	103	881	601	17	0.052	0.44	0.30	0.0084		0.052	0.44	0.30	0.0084
		NE = Not Estimated																			
Control Structure Excavation Annual Average Emissions (All in 2011)																	2011	1.95	15.16	13.09	0.49
Total Control Structure 2011 Emissions (Excavation plus Concrete Placement)																	2011	2.30	17.96	15.19	0.55
CONTROL STRUCTURE - Gate Installation (9 months)			December 2013 through July 2014																		
Track driven cranes	2	8	5	5		80	1,600	200	288	2,454	1,674	46	0.144	1.23	0.84	0.0230		0.144	1.227	0.837	0.023
Flat bed trucks									Off-site Haul Truck calculations									Off-site Haul Truck calculations			
Control Structure Gate Installation Annual Average Emissions (Assume in 2014)																		0.144	1.227	0.837	0.023
CHUTE AND STILLING BASIN - Concrete Placement and Batch Plant (36 months)				Late 2013 through 2016																	
Semi-trailer truck	20	4	5	36		400	57,600	7,200	Off-site Haul Truck calculations									Off-site Haul Truck calculations			
Belly dump truck	8	4	3	36		96	13,824	1,728	Off-site Haul Truck calculations									Off-site Haul Truck calculations			
Tanker trucks	2	4	3	36		24	3,456	432	192	957	1,165	67	0.096	0.48	0.58	0.0337		0.03	0.16	0.19	0.011
Chiller	1	10	5	36		50	7,200	900	1,872	15,399	11,556	351	0.936	7.70	5.78	0.1755		0.31	2.57	1.93	0.059
Stationary Cranes - electric	2	8	5	36		80	11,520	1,440	0	0	0	0	0	0	0	0		0	0	0	0
Forklifts	2	4	5	36		40	5,760	720	569	4,824	3,290	94	0.284	2.41	1.65	0.0468		0.095	0.804	0.548	0.016
Man lift/scissor lift - electric	2	8	5	36		80	11,520	1,440	0	0	0	0	0	0	0	0		0	0	0	0
Water truck	1	4	5	36		20	2,880	360	160	798	971	56	0.080	0.40	0.49	0.0281		0.03	0.13	0.16	0.009
Street sweeper	1	8	1	36		8	1,152	144	300	2,464	1,849	56	0.150	1.23	0.92	0.0281		0.050	0.411	0.31	0.0094
Jackhammers	2	8	1	36		16	2,304	288	599	4,928	3,698	112	0.300	2.46	1.85	0.0562		0.10	0.82	0.62	0.019
Cement mixers (transit)	0	4	5	36		0	0	0	0	0	0	0	0.000	0.00	0.00	0.0000		0.00	0.00	0.00	0.00
Front end loaders	2	8	5	36		80	11,520	1,440	936	7,718	5,789	173	0.468	3.86	2.89	0.0864		0.16	1.29	0.96	0.029
Flatbed delivery truck	1		5						Off-site Haul Truck calculations									Off-site Haul Truck calculations			
CHUTE AND STILLING BASIN - Foundation Preparation/Backfill (36 months)				Late 2013 through 2016																	
Fuel truck	1	2	5	36		10	1,440	180	80	399	485	28	0.040	0.20	0.24	0.0140		0.013	0.066	0.081	0.005
Water truck	1	4	5	36		20	2,880	360	160	798	971	56	0.080	0.40	0.49	0.0281		0.027	0.133	0.162	0.009
Front end loader	1	4	5	36		20	2,880	360	234	1,930	1,447	43	0.117	0.96	0.72	0.0216		0.039	0.322	0.241	0.0072
Pickup trucks	5	4	5	36		100	14,400	1,800	121	1,145	132	10	0.060	0.57	0.07	0.0049		0.020	0.191	0.022	0.002
Track driven cranes	2	4	5	24		40	3,840	480	691	5,890	4,018	110	0.346	2.94	2.01	0.0552		0.173	1.472	1.004	0.028
Drills for grouting - electric	6	8	5	24		240	23,040	2,880	0	0	0	0	0.000	0.00	0.00	0.0000		0.000	0.000	0.000	0.00
Portable cement mixers	2	4	5	12		40	1,920	240	499	4,106	3,082	94	0.250	2.05	1.54	0.0468		0.250	2.053	1.541	0.047
Chute and Stilling Basin Annual Average Emissions (Assume emissions in 2014, 2015, 2016)																		1.29	10.42	7.77	0.25

BORINGS FOR APPROACH CHANNEL COFFERDAM (4 months)				Late 2010 - Early 2011																
Diesel & Hydraulic drill rig	1	10	5	4		50	800	100	97	603	919	47	0.048	0.30	0.46	0.0235	0.048	0.30	0.46	0.023
Flat bed trucks	2	4	5	4					Off-site Haul Truck calculations								Off-site Haul Truck calculations			
Borings for Approach Channel Annual Average Emissions (Assume in 2010)																	0.048	0.30	0.46	0.023
TOTAL EMISSIONS									12,076	95,928	75,625	2,576	6.0	48.0	37.8	1.3				

Approximate 2010 annual unmitigated emissions:	0.05	0.30	0.46	0.023
Approximate 2011 annual unmitigated emissions:	2.30	17.96	15.19	0.55
Approximate 2012 annual unmitigated emissions:	0.69	5.59	4.20	0.13
Approximate 2013 annual unmitigated emissions:	0.34	2.80	2.10	0.07
Approximate 2014 annual unmitigated emissions:	1.44	11.65	8.61	0.27
Approximate 2015 annual unmitigated emissions:	1.29	10.42	7.77	0.25
Approximate 2016 annual unmitigated emissions:	1.29	10.42	7.77	0.25

Construction Equipment Emission Rates (pounds per day) from Reclamation 2007

Equipment Type	ROG	CO	NO_x	PM_{10}
Bore/Drill Rigs				
2009	2.38	20.21	16.41	0.38
2010-2016	2.26	19.23	15.61	0.36
Paving Equipment				
2009	1.04	8.23	6.78	0.22
2010-2016	1.04	8.52	6.39	0.19
Rollers				
2009	0.86	7.34	5.01	0.14
2010-2016	0.86	7.34	5.01	0.14
Cranes				
2009	1.44	12.27	8.37	0.23
2010-2016	1.44	12.27	8.37	0.23
Crawler Tractors				
2009	1.45	11.55	9.5	0.31
2010-2016	1.45	11.95	8.96	0.27
Crushing/Proc Equipment				
2009	2.12	16.86	13.88	0.45
2010-2016	2.12	17.45	13.09	0.4
Rough Terrain Forklifts				
2009	0.79	6.7	4.57	0.13
2010-2016	0.79	6.7	4.57	0.13
Rubber Tired Dozers				
2009	3.66	29.13	23.97	0.78
2010-2016	3.66	30.14	22.61	0.68
Rubber Tired Loaders				
2009	1.35	11.52	7.86	0.22
2010-2016	1.35	11.52	7.86	0.22
Excavators				
2009	1.84	15.64	10.67	0.29
2010-2016	1.84	15.64	10.67	0.29
Graders				
2009	1.76	14.98	10.22	0.28
2010-2016	1.76	14.98	10.22	0.28
Off-Highway Tractors/Compactors				
2009	1.84	14.65	12.05	0.39
2010-2016	1.84	15.16	11.37	0.34
Scrapers				
2009	3.64	30.96	21.12	0.58
2010-2016	3.64	30.96	21.12	0.58
Skid Steer Loaders				
2009	0.56	4.78	3.26	0.09
2010-2016	0.56	4.78	3.26	0.09
Off-Highway Trucks/Water Trucks				
2009	3.6	30.62	20.89	0.58
2010-2016	3.6	30.62	20.89	0.58
Other Construction Equipment				
2009	2.08	16.54	13.61	0.44
2010-2016	2.08	17.11	12.84	0.39
Pavers				
2009	1.37	11.62	7.93	0.22
2010-2016	1.37	11.62	7.93	0.22
Surfacing Equipment				
2009	3.77	29.99	24.68	0.8
2010-2016	3.77	31.03	23.28	0.7
Tractors/Loaders/Backhoes				
2009	0.65	5.18	4.26	0.14
2010-2016	0.65	5.36	4.02	0.12
Trenchers				
2009	1.00	8.53	5.82	0.16
2010-2016	1.00	8.53	5.82	0.16

Emission factors for ROG, CO, NOx, PM10 from (Reclamation 2007)

Assume: Emission rates from 2011 to 2016 are equal to 2010
Eight hour work day

Construction Equipment Emission Rates (pounds per day) from Corps 2009

Equipment Type	ROG	CO	NO_x	PM_{10}
Bore/Drill Rigs				
175 Horsepower	0.966	6.033	9.19	0.469
Pickups[1]				
Pounds/1,000 miles	1.12	10.6	1.22	0.0905
Pounds/day	0.0672	0.636	0.0732	0.00543
Heavy-heavy duty diesel truck 2009[2]				
Pounds per mile	0.00739	0.03694	0.04495	0.0026
Pounds/day	0.4434	2.2164	2.697	0.156

Project will use 140 hp drills

[1] Assume: Pickups in use 4 hours per day, maximum speed is 15 mph, maximum distance per day is 60 miles.
[2] Assume: Trucks in use 4 hours per day, maximum speed is 15 mph, maximum distance per day is 60 miles.

Emissions: On-Site and Off-Site Haul Trucks Exhaust

(Based on Vehicle Miles Traveled)

Assumptions and Emission Factors from: Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009)

ON-SITE HAUL TRUCKS

EMISSION FACTORS

	Emission Rate in grams per mile						
Vehicle Description	**CO**	**CO_2**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_x**	**ROG**
Heavy-Heavy Duty Diesel Truck 2009	16.75	2,516.08	20.39	1.18	1.05	0.02	3.35

Emission Factor from (Corps 2009) Appendix A: On-site Truck Emissions

	Emission Rate in pounds per mile						
Vehicle Description	**CO**	**CO_2**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_x**	**ROG**
Heavy-Heavy Duty Diesel Truck 2009	0.03693	5.5469	0.04495	0.00260	0.00231	0.0000441	0.00739

Emission Factor calculated based on conversion factor of 0.0022046 to convert from grams to pounds

CONTROL STRUCTURE - Excavation (9 months) Jan - Sept 2011

				Emissions in pounds							Emissions in tons						
Vehicle	**Miles per round trip**	**Number of trips**	**Total Miles**	**CO**	**CO_2**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_x**	**ROG**	**CO**	**CO_2**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_x**	**ROG**
"Super" dump truck (hauling to MIAD)	3	6,400	19,200	709	106,501	863	50	44	0.85	142	0.35	53.25	0.43	0.025	0.022	0.00042	0.071

Miles: 19,200

	Total Emissions in tons						
	CO	**CO_2**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_x**	**ROG**
TOTAL ON-SITE HAUL TRUCK EMISSIONS	0.35	53.25	0.43	0.025	0.022	0.00042	0.071
Average annual on-site haul truck emissions (9 months):	0.35	53.25	0.43	0.025	0.022	0.00042	0.071

OFF-SITE HAUL TRUCKS

EMISSION FACTORS

	Emission Rate in pounds per mile						
Vehicle Description	**CO**	**CO_2**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_x**	**ROG**
Heavy-Heavy Duty Diesel Truck 2009	0.010	4.21	0.040	0.00153	0.00132	0.0000301	0.00268

Emission Factor from (Corps 2009) Appendix A: Off-site Truck Emissions

CONTROL STRUCTURE - Concrete Placement and Batch Plant (24 months) and Gate Intallation (9 months) Concrete Placement and Batch Plant - July 2011 through July 2013; Gate Installation - December 2013 through July 2014

				Emissions in pounds							Emissions in tons						
Vehicle	**Miles per trip**	**Number of trips**	**Total Miles**	**CO**	**CO_2**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_x**	**ROG**	**CO**	**CO_2**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_x**	**ROG**
Off-site deliveries of material	10	230	2,300	23.0	9,683	92	3.5	3.0	0.069	6.16	0.0115	4.84	0.046	0.0018	0.0015	0.000035	0.0031
Aggregate delivery for concrete	36	9,700	349,200	3,492.0	1,470,132	13,968	534	460.9	10.511	935.86	1.7460	735.07	6.98	0.2671	0.2305	0.0053	0.47
Delivery of reinforcing bars	10	66	660	6.6	2,779	26	1.0	0.9	0.020	1.77	0.0033	1.39	0.0132	0.0005	0.0004	0.000010	0.0009
Delivery of Bulkhead gates	30	6	180	1.8	758	7	0.3	0.2	0.005	0.48	0.0009	0.38	0.0036	0.00014	0.00012	0.000003	0.0002
Delivery of Taintor gates	30	6	180	1.8	758	7	0.3	0.2	0.005	0.48	0.0009	0.38	0.0036	0.00014	0.00012	0.000003	0.0002
Delivery of Trunion girders	30	6	180	1.8	758	7	0.28	0.24	0.005	0.48	0.0009	0.38	0.0036	0.00014	0.00012	0.0000027	0.00024
Delivery of stairs and handrails	30	3	90	0.90	379	4	0.14	0.12	0.0027	0.24	0.0005	0.19	0.0018	0.000069	0.000059	0.0000014	0.00012
Delivery of walkways, steel grating	30	5	150	1.5	632	6	0.23	0.20	0.0045	0.40	0.0008	0.32	0.0030	0.00011	0.00010	0.0000023	0.00020
Delivery of trunnion and guides	30	12	360	3.6	1,516	14	0.55	0.48	0.011	0.96	0.0018	0.76	0.0072	0.00028	0.00024	0.0000054	0.00048
Delivery of misc. electrical, HVAC	10	1,200	12,000	120.0	50,520	480	18.4	15.8	0.361	32.16	0.0600	25.26	0.2400	0.0092	0.0079	0.00018	0.016
Delivery for construction of batch plant	20	10	200	2.0	842	8	0.3	0.3	0.006	0.54	0.0010	0.42	0.0040	0.0002	0.0001	0.00000	0.000
Delivery of concrete from off-site source	20	41	820	8.2	3,452	33	1.3	1.1	0.025	2.20	0.0041	1.73	0.0164	0.0006	0.0005	0.00001	0.001
Total				3,663.2	1,542,207.2	14,652.8	560.5	483.5	11.0	981.7	1.83	771.10	7.33	0.28	0.24	0.0055	0.49
Average Annual emissions (based on 33 months)				1,332.1	560,802.6	5,328.3	203.8	175.8	4.0	357.0	0.67	280.40	2.66	0.10	0.088	0.0020	0.18

Miles: 366,320

CHUTE AND STILLING BASIN - Concrete Placement and Batch Plant/Foundation Preparation/Backfill (36 months) Late 2013 through 2016

				Emissions in pounds							Emissions in tons						
Vehicle	**Miles per trip**	**Number of trips**	**Total Miles**	**CO**	**CO_2**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_x**	**ROG**	**CO**	**CO_2**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_x**	**ROG**
Off-site deliveries of material	10	230	2,300	23.0	9,683	92	3.5	3.0	0.069	6.16	0.0115	4.84	0.046	0.0018	0.0015	0.000035	0.0031
Aggregate delivery for concrete	36	13,000	468,000	4,680.0	1,970,280	18,720	716	617.8	14.087	1,254.24	2.3400	985.14	9.36	0.3580	0.3089	0.0070	0.63
Delivery of reinforcing bars	10	169	1,690	16.9	7,115	68	2.6	2.2	0.051	4.53	0.0085	3.56	0.0338	0.0013	0.0011	0.000025	0.0023
Delivery of misc. electrical, HVAC	10	100	1,000	10.0	4,210	40	1.5	1.3	0.030	2.68	0.0050	2.11	0.0200	0.0008	0.0007	0.00002	0.001
Delivery of concrete from off-site source	20	40	800	8.0	3,368	32	1.2	1.1	0.024	2.14	0.0040	1.68	0.0160	0.0006	0.0005	0.00001	0.001
Total				4,737.9	1,994,655.9	18,951.6	724.9	625.4	14.3	1,269.8	2.37	997.33	9.48	0.36	0.31	0.0071	0.63
Average Annual emissions (based on 36 months)				1,579.3	664,885.3	6,317.2	241.6	208.5	4.8	423.3	0.79	332.44	3.16	0.12	0.10	0.0024	0.21

Miles: 473,790

TOTAL PROJECT OFF-SITE MILES (69 months) July 2011 through 2016

TOTAL OFF-SITE MILES:	840,110
Average annual off-site truck miles (based on 69 months, or 5.75 years)	146,106

	Total Emissions in tons						
	CO	**CO_2**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**SO_x**	**ROG**
TOTAL OFF-SITE HAUL TRUCK EMISSIONS:	4.2	1,768.4	16.8	0.64	0.55	0.0126	1.13
Average annual off-site haul truck emissions (69 months, or 5.75 years):	0.73	307.55	2.92	0.11	0.10	0.0022	0.20

Emissions - Worker Commute Exhaust

Assumptions and Emission Factors from: Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009)
Emission Factor from (Corps 2009)

Vehicle Description	Emission Rate in Pounds Per 1000 Miles						
	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Light Duty Automobile (LDA)	8.87	832	0.756	0.0694	0.0393	0.00786	0.991
Light Duty Truck (LDT)	10.6	1020	1.22	0.0905	0.0566	0.0131	1.12
Average based on 50 percent LDA and 50 percent LDT	9.75	927	0.99	0.08	0.0479	0.00959	1.06

Control Structure

Workers	70	**(Jan 2011 through July 2014)**	
Workers per vehicle	2	Period of Operation (months)	42
Commuter vehicles per day	35	Workdays per week	5
Vehicles from Sacramtento (80%)	28	Workdays per month	20
Vehicles from Folsom (20%)	7	Workdays in period	840
Roundtrip to Sacramento (miles)	60		
Roundtrip to Folsom (miles)	10		
Daily Miles:	1,750		
Annual Miles:	420,000		
COMMUTER MILES (42 months)	1,470,000		
COMMUTER MILES (42 months)/1000	1470		

Operation (months)[1]	
Excavation	9
Aggregate and concrete	24
Gate installation	9
	42

[1] Assume no overlap

Emissions	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Total Pounds	14,332.50	1,362,690.00	1,455.30	117.60	70.41	14.10	1,558.20
Total Tons	7.17	681.35	0.73	0.059	0.035	0.0070	0.78
Average annual pounds	4,095.00	389,340.00	415.80	33.60	20.12	4.03	445.20
Average annual tons	2.05	194.67	0.21	0.017	0.010	0.0020	0.22

Chute and Stilling Basin

Workers	70	**(late 2013 through 2016)**	
Workers per vehicle	2	Period of Operation (months)	36
Commuter vehicles per day	35	Workdays per week	5
Vehicles from Sacramtento (80%)	28	Workdays per month	20
Vehicles from Folsom (20%)	7	Workdays in period	720
Roundtrip to Sacramento (miles)	60		
Roundtrip to Folsom (miles)	10		
Daily Miles:	1,750		
Annual Miles:	420,000		
COMMUTER MILES (36 months)	1,260,000		
COMMUTER MILES (36 months)/1000	1,260		

Emissions	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Total Pounds	12,285.00	1,168,020.00	1,247.40	100.80	60.35	12.08	1,335.60
Total Tons	6.14	584.01	0.62	0.050	0.030	0.0060	0.67
Average annual pounds	4,095.00	389,340.00	415.80	33.60	20.12	4.03	445.20
Average annual tons	2.05	194.67	0.21	0.017	0.010	0.0020	0.22

Borings for Approach Channel Cofferdam

Workers	4	**(Oct 2010 through Jan 2011)**	
Workers per vehicle	1	Period of Operation (months)	4
Commuter vehicles per day	4	Workdays per week	5
Vehicles from Sacramtento (100%)	4	Workdays per month	20
Vehicles from Folsom (0%)	0	Workdays in period	80
Roundtrip to Sacramento (miles)	60		
Roundtrip to Folsom (miles)	10		
Daily Miles:	240		
Annual Miles:	19,200		
COMMUTER MILES (4 months)	19,200		
COMMUTER MILES (4 months)/1000	19.2		

Emissions	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
Pounds	187.20	17,798.40	19.01	1.54	0.92	0.18	20.35
Tons	0.094	8.90	0.010	0.00077	0.00046	0.000092	0.010

Total Commuter Emissions	CO	CO_2	NO_x	PM_{10}	$PM_{2.5}$	SO_x	ROG
	26,804.70	2,548,508.40	2,721.71	219.94	131.69	26.36	2,914.15
	13.40	1,274.25	1.36	0.110	0.066	0.013	1.46

Total Commuter Vehicle Miles Traveled 2,749,200

Fugitive Dust - Cumulative Activities

PM_{10} and Fugitive Dust Pollutants

Borings for Approach Channel Cofferdam

(Oct 2010 through Jan 2011)
Period of Operation (months) 4

Based on AP-42 Table 11.9-4
TSP Emissions = 1.3 pounds per hole
Assume: 100% TSP = PM_{10}; 15 borings -

	Unmitigated PM_{10}	Unmitigated $PM_{2.5}$	Mitigated PM_{10}	Mitigated $PM_{2.5}$	
Tons per year	0.00975	0.00975	0.00975	0.00975	No mitigations
Total annual average tons	0.010	0.010	0.010	0.010	

Control Structure

(Jan 2011 through July 2014)
Period of Operation (months) 42
Excavation: 9 months - January through September, 2011
Aggregate and Concrete: 24 months - July 2011 through July 2013
Gate Installation: 9 months - December 2013 through July 2014

	Unmitigated PM_{10}	Unmitigated $PM_{2.5}$	Mitigated	Mitigated PM_{10}	Mitigated $PM_{2.5}$
Excavation Cut and Fill (Urbemis 2007) — Tons per year	18.36	3.8	Mitigated (55 % reduction) (Basic Construction Emission Control Practices)	8.3	1.7
Paved Road - Haul Truck — Tons per year	2.54	0.35	Mitigated (no mitigations)	2.54	0.35
Paved Road - Worker Commuter Travel — Tons per year	0.084	0.0060	Mitigated (no mitigations)	0.084	0.0060
Unpaved Road - Haul Truck — Tons per year	20.0	2.0	Mitigated (55 % reduction)	9.0	0.91
Material Storage Pile Handling - Excavation — Tons per year	0.025	0.0038	Mitigated (90% reduction)	0.0025	0.00038
Material Storage Pile Handling - Aggregate — Tons per year	0.0038	0.00057	Mitigated (90% reduction)	0.00038	0.000057
Stockpile Wind Erosion - Excavation — Tons per year	17.9	2.7	Mitigated (90% reduction)	1.79	0.27
Stockpile Wind Erosion - Aggregate — Tons per year	3.6	0.54	Mitigated (90% reduction)	0.36	0.054
Blasting (with Drilling) — Tons per year	20.4	0.00	Mitigated	11.0	0.00
Concrete Batch Plant — Tons per year	97.0	0.00	Mitigated	1.6	0.00
Total Avg Tons per year (Control Structure)	179.8	9.4		34.7	3.3

Chute and Stilling Basin

(late 2013 through 2016)
Period of Operation (months) 36

	Unmitigated PM_{10}	Unmitigated $PM_{2.5}$	Mitigated	Mitigated PM_{10}	Mitigated $PM_{2.5}$
Paved Road - Haul Truck — Tons per year	3.02	0.42	Mitigated (no mitigations)	3.02	0.42
Paved Road - Worker Commuter Travel — Tons per year	0.084	0.0060	Mitigated (no mitigations)	0.084	0.0060
Material Storage Pile Handling - Excavation[1] — Tons per year	0.025	0.0038	Mitigated (90% reduction)	0.0025	0.00038
Material Storage Pile Handling - Aggregate — Tons per year	0.0055	0.00083	Mitigated (90% reduction)	0.00055	0.000083
Stockpile Wind Erosion - Aggregate — Tons per year	5.2	0.79	Mitigated (90% reduction)	0.52	0.079
Concrete Batch Plant — Tons per year	84.9	0.00	Mitigated	1.4	0.00
Total Avg Tons per year (Chute and Stilling Basin)	93.23	1.22		5.03	0.51

[1] Although excavation is not planned during the chute and stilling basin construction phase, PM_{10} emissions are listed to give the most conservative estimate.

FUGITIVE DUST Emissions: Paved Roads

Methodology from AP-42 , Fifth Edition, Volume 1 Chapter 13.2.1: Paved Roads
Assumptions and Emission Factors from Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009)
VMT = Vehicle Miles Traveled

Assumptions for Worker Commuter Travel based on Corps 2009.

Worker commuter fleet is 50 percent light duty automobile (LDA) and 50 percent light duty truck (LDT).
Average Vehicle Weight (W) is 1.75 tons.

Roadway Surface Type	Travel Fraction	PM_{10} Particulate Emission Factor (lb/VMT)	PM_{10} Long-Term Particulate Emission Factor (lb/VMT)	$PM_{2.5}$ Particulate Emission Factor (lb/VMT)	$PM_{2.5}$ Long-Term Particulate Emission Factor (lb/VMT)
Freeway	0.235	<0	<0	<0	<0
Arterial/Major street	0.587	0.000044	0.0000413	<0	<0
Collector Road	0.072	0.000044	0.0000413	<0	<0
Local Road	0.052	0.0017	0.00159	<0	<0
Rural Road	0.054	0.0057	0.00534	0.000565	0.00053

Note: AP-42 , Fifth Edition, Volume 1 Chapter 13.2.1, page 13.2.1-5 states "There may be situations where low silt loading and/or low average weight will yield calculated negative emissions. If this occurs, the emissions calculated from the equation should be set to zero.

Assumptions for Heavy Heavy Diesel Truck Travel based on Corps 2009.

Average Vehicle Weight (W) is 23.25 tons.

Roadway Surface Type	Travel Fraction	PM_{10} Particulate Emission Factor (lb/VMT)	PM_{10} Long-Term Particulate Emission Factor (lb/VMT)	$PM_{2.5}$ Particulate Emission Factor (lb/VMT)	$PM_{2.5}$ Long-Term Particulate Emission Factor (lb/VMT)
Freeway	0.235	0.02	0.02	0.00224	0.0021
Arterial/Major street	0.587	0.02	0.02	0.00337	0.00317
Collector Road	0.072	0.02	0.02	0.00337	0.00317
Local Road	0.052	0.1	0.1	0.02	0.01
Rural Road	0.054	0.3	0.28	0.04	0.04

Note: Long-term particulate emission factor considers natural mitigation with precipitation.

Fugitive Dust Annual Emission Calculations for Worker Commuter Travel.

Maximum annual commuter miles traveled: 420,000
*Both **Control Structure** and **Chute and Stilling Basin**
*January 2011 through 2016
Total commuter miles traveled for entire project: 2,749,200

Roadway surface	Annual VMT (miles)	Annual PM_{10} Emissions (ton/year)	Annual PM_{10} Annual Long-Term Emissions (ton/year)	Annual $PM_{2.5}$ Emissions (ton/year)	Annual $PM_{2.5}$ Annual Long-Term Emissions (ton/year)
Freeway	98,700	0	0	0	0
Arterial/Major street	246,540	0.0054	0.0051	0	0
Collector Road	30,240	0.00067	0.00062	0	0
Local Road	21,840	0.019	0.017	0	0
Rural Road	22,680	0.065	0.061	0.0064	0.0060
Totals:		0.089	0.084	0.006	0.0060

CONTROL STRUCTURE - Fugitive Dust Annual Emission Calculations for Off-Site Truck Travel

Total off-site truck miles: 366,320   Months: 33
Average annual off-site truck miles: 133,207

Roadway surface	Annual VMT (miles)	Annual PM_{10} Emissions (ton/year)	Annual PM_{10} Annual Long-Term Emissions (ton/year)	Annual $PM_{2.5}$ Emissions (ton/year)	Annual $PM_{2.5}$ Annual Long-Term Emissions (ton/year)
Freeway	31,304	0.31	0.31	0.035	0.033
Arterial/Major street	78,193	0.78	0.78	0.13	0.12
Collector Road	9,591	0.10	0.10	0.016	0.015
Local Road	6,927	0.35	0.35	0.07	0.035
Rural Road	7,193	1.08	1.01	0.14	0.144
		2.62	2.54	0.40	0.35

Notes: Total off-site truck miles calculated on "On-Site and Off-Site Haul Trucks Exhaust" page
Assumes 24 months for concrete placement and 9 months for gate installation.

CHUTE and STILLING BASIN - Fugitive Dust Annual Emission Calculations for Off-Site Truck Travel

Total off-site truck miles: 473,790   Months: 36
Average annual off-site truck miles: 157,930

Roadway surface	Annual VMT (miles)	Annual PM_{10} Emissions (ton/year)	Annual PM_{10} Annual Long-Term Emissions (ton/year)	Annual $PM_{2.5}$ Emissions (ton/year)	Annual $PM_{2.5}$ Annual Long-Term Emissions (ton/year)
Freeway	37,114	0.37	0.37	0.042	0.039
Arterial/Major street	92,705	0.93	0.93	0.16	0.15
Collector Road	11,371	0.11	0.11	0.019	0.018
Local Road	8,212	0.41	0.41	0.08	0.041
Rural Road	8,528	1.28	1.19	0.17	0.17
		3.10	3.02	0.47	0.42

Notes: Total off-site truck miles calculated on "On-Site and Off-Site Haul Trucks Exhaust" page

FUGITIVE DUST Emissions: Unpaved Roads

Methodology from AP-42 , Fifth Edition, Volume 1 Chapter 13.2.2: Unpaved Roads
Assumptions and Emission Factors from: Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009)
VMT = Vehicle Miles Traveled

Assumptions for Heavy Heavy Diesel Truck Travel based on Corps 2009.

Average Vehicle Weight (W) is 23.25 tons.

	PM_{10} Particulate Emission Factor (lb/VMT)	PM_{10} Long-Term Particulate Emission Factor [Naturally Mitigated] (lb/VMT)	$PM_{2.5}$ Particulate Emission Factor (lb/VMT)	$PM_{2.5}$ Long-Term Particulate Emission Factor [Naturally Mitigated] (lb/VMT)
Unpaved Road	2.76	2.08	0.28	0.21

Note: Long-term particulate emission factor considers natural mitigation with precipitation.

Fugitive Dust Annual Emission Calculations for On-Site Truck Travel during excavation.

Nine months on-site truck miles: 19,200
(excavation hauling to MIAD)

Roadway surface	Annual VMT (miles)	Unmitigated Annual PM_{10} Emissions (ton/year)	Annual PM_{10} Annual Long-Term Emissions [Naturally Mitigated] (ton/year)	Unmitigated Annual $PM_{2.5}$ Emissions (ton/year)	Annual $PM_{2.5}$ Annual Long-Term Emissions [Naturally Mitigated] (ton/year)
Unpaved Road	19,200	26.50	19.97	2.69	2.02
55 percent control factor for road dust for watering twice a day.					Mitigated emission:
			8.9856		0.9072

MIAD Mormon Island Auxiliary Dam (disposal and course material stockpiling for U.S. Army Corps of Engineers).

FUGITIVE DUST Emissions: Excavated Material Storage Piles

Methodology from AP-42 , Fifth Edition, Volume 1 Chapter 13.2.4: Aggregate Handling and Storage Piles
Assumptions and Emission Factors from: Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009)

Assumptions for Excavation Stockpile Handling Emissions based on Corps 2009.

Mean wind speed (mph)	5.1
Material moisture content (%)	7.9
Density of weathered granite (lb/cy)	1,850
Wet suppression controls (%)	90

Emission factor for PM_{10} stockpile emissions (lb/ton):	0.000168
Emission factor for $PM_{2.5}$ stockpile emissions (lb/ton):	0.0000254

mph = miles per hour
% = percent
lb/cy = pounds per cubic yard
lb/ton = pounds per ton

Fugitive Dust Emission Calculations for Excavation Stockpile Handling

Period of Excavation (months):	9
Common Excavation (cy)[1]:	20,000
Rock Excavation (cy)[1]:	300,000
Total Excavation (cy)[1]:	320,000

Stockpile amount (tons):	296,000

Parameter	Stockpile Amount (tons)	Emission Factor (lb/ton)	Emission Controls (percent)	Unmitigated emissions (tons/year)	Mitigated emissions (tons/year)
PM_{10}	296,000	0.000168	90	0.025	0.0025
$PM_{2.5}$	296,000	0.0000254	90	0.0038	0.00038

[1] Based on Folsom Dam JFP Teleconference Notes, Air Analysis Revisions, June 8, 2010

Assumptions: The excavated material will be added to the storage pile during construction of the Control Structure.
The excavated material will still be in place during the Chute and Stilling Basin construction phase.

FUGITIVE DUST Emissions: Aggregate Material Storage Piles (for concrete batch plants)

Methodology from AP-42 , Fifth Edition, Volume 1 Chapter 13.2.4: Aggregate Handling and Storage Piles
Assumptions and Emission Factors from: Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009)

Assumptions for Excavation Stockpile Handling Emissions based on Corps 2009.

Mean wind speed (mph)	5.1
Material moisture content (%)	7.9
Density of weathered granite (lb/cy)	1,850
Wet suppression controls (%)	90
Emission factor for PM_{10} stockpile emissions (lb/ton):	0.000168
Emission factor for $PM_{2.5}$ stockpile emissions (lb/ton):	0.0000254

Fugitive Dust Emission Calculations for Aggregate Stockpile Handling

Control Structure Concrete Emplacement (months):	24
Chute and Stilling Basin Concrete Emplacement (months):	36
Total Control Structure Aggregate (cy)[1]:	97,000
Total Chute and Stilling Basin Aggregate (cy)[2]:	211,068
Entire Project Length - Total Aggregate (cy):	308,068
Entire Project Length - Total Aggregate (tons):	284,963

Annual Control Structure Aggregate (cy):	48,500
Annual Chute and Stilling Basin Aggregate (cy):	70,356
Annual Control Structure Aggregate (tons):	44,863
Annual Chute and Stilling Basin Aggregate (tons):	65,079

	Control Structure					Chute and Stilling Basin				
Parameter	Annual Stockpile Amount (tons)	Emission Factor (lb/ton)	Emission Controls (percent)	Unmitigated emissions (tons/year)	Mitigated emissions (tons/year)	Annual Stockpile Amount (tons)	Emission Factor (lb/ton)	Emission Controls (percent)	Unmitigated emissions (tons/year)	Mitigated emissions (tons/year)
PM_{10}	44,863	0.000168	90	0.0038	0.00038	65,079	0.000168	90	0.0055	0.00055
$PM_{2.5}$	44,863	0.0000254	90	0.00057	0.000057	65,079	0.0000254	90	0.00083	0.000083

mph = miles per hour
% = percent
lb/cy = pounds per cubic yard
lb/ton = pounds per ton

[1] Based on March 5, 2010, equipment list spreadsheet (equipmentjfrMarch 5.xls)
[2] Based on June 15, 2010, email attachment from Jane Rinck to Garrett Smith and Leroy Shaser (commentary.docx).

FUGITIVE DUST Emissions: Excavated Stockpile Wind Erosion

Methodology from AP-42 , Fifth Edition, Volume 1 Chapter 13.2.5: Industrial Wind Erosion
Assumptions and Emission Factors from: Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009)

$$\text{Emission Factor (EF) in g/m}^2 = k \sum_{i=1}^{N} P_i$$

Where:

k = Particle Size Multiplier (dimensionless)
N = Number of Disturbances per Year
P_i = Erosion Potential Corresponding to the Observed Fasted Mile of Wind for the ith Period Between Disturbances

Assumptions for Stockpile Wind Erosion Emissions based on Corps 2009.

k for PM_{10}	0.5
k for $PM_{2.5}$	0.075
P_i: Erosion Potential (g/m^2)	7.37
Wet suppression controls (%)	90

Fugitive Dust Emission Calculations for Stockpile Wind Erosion

Period of Excavation (months):	9
Workdays per Month:	20
Total workdays:	180
N = Number of Disturbances (assume one per workday)	180
Total Material Excavated and Stored: (cy)[1]:	320,000
Total Material Excavated and Stored: (cubic m)[2]:	244,659

PM_{10} EF (g/m^2) =	663.3
$PM_{2.5}$ EF (g/m^2) =	99.495
Stockpile Area (sq m)[3]:	24,465.9

Parameter	Emission Factor (g/m^2)	Stockpile Area (m^2)	Emission Controls (percent)	Unmitigated emissions (g/year)	Mitigated emissions (g/year)	Unmitigated emissions[4] (tons/year)	Mitigated emissions[4] (tons/year)
PM_{10}	663.3	24,465.9	90	16,228,245	1,622,824	17.9	1.79
$PM_{2.5}$	99.50	24,465.9	90	2,434,237	243,424	2.68	0.27

cy = cubic yards
g = gram
m = meter
% = percent

[1] Based on Project Description
[2] Conversion Factor: Cubic Yard * 0.76456 = Cubic Meter
[3] Assume Stockpile is 10 Meters Deep
[4] Conversion Factor: Grams*0.0000011023 = Ton

FUGITIVE DUST Emissions: Aggregate Stockpile Wind Erosion (for concrete batch plants)

Methodology from AP-42 , Fifth Edition, Volume 1 Chapter 13.2.5: Industrial Wind Erosion
Assumptions and Emission Factors from: Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009)

Emission Factor (EF) in g/m² = $k \sum_{i=1}^{N} P_i$

Where:

k = Particle Size Multiplier (dimensionless)
N = Number of Disturbances per Year
P_i = Erosion Potential Corresponding to the Observed Fasted Mile of Wind for the ith Period Between Disturbances

Assumptions for Stockpile Wind Erosion Emissions based on Corps 2009.

k for PM_{10}	0.5
k for $PM_{2.5}$	0.075
P_i: Erosion Potential (g/m²)	7.37
Wet suppression controls (%)	90

Fugitive Dust Emission Calculations for Stockpile Wind Erosion

Control Stucture Concrete Placement (months):	24
Chute and Stilling Basin Concrete Placement (months):	36
Total Control Structure Aggregate (cy)[a]	97,000
Annual - Control Structure Aggregate (cy)	48,500
Annual - Control Structure Aggregate (cubic m)[1]	37,081
Total Chute and Stilling Basin Aggregate (cy)[b]	211,068
Annual - Chute and Stilling Basin Aggregate (cy)	70,356
Annual - Chute and Stilling Basin Aggregate (cubic m)[1]	53,791

Annual Workdays:	240
Annual Workdays:	240
N = Assume one disturbance per workday	
PM_{10} EF (g/m²) =	884.4
$PM_{2.5}$ EF (g/m²) =	132.7

Annual Control Structure Stockpile Area[2]: 3,708 square meter
Annual Chute and Stilling Basin Stockpile Area[2]: 5,379 square meter

Control Structure							
Parameter	Emission Factor (g/m²)	Annual Stockpile Area (m²)	Emission Controls (percent)	Unmitigated emissions (g/year)	Mitigated emissions (g/year)	Unmitigated emissions[4] (tons/year)	Mitigated emissions[4] (tons/year)
PM_{10}	884.4	3,708.1	90	3,279,458	327,946	3.6	0.36
$PM_{2.5}$	132.66	3,708.1	90	491,919	49,192	0.54	0.054

Chute and Spilling Basin							
Parameter	Emission Factor (g/m²)	Annual Stockpile Area (m²)	Emission Controls (percent)	Unmitigated emissions (g/year)	Mitigated emissions (g/year)	Unmitigated emissions[4] (tons/year)	Mitigated emissions[4] (tons/year)
PM_{10}	884.4	5,379.1	90	4,757,310	475,731	5.2	0.52
$PM_{2.5}$	132.66	5,379.1	90	713,596	71,360	0.79	0.079

cy = cubic yards
g = gram
m = meter
% = percent

[1] Conversion Factor: Cubic Yard * 0.76456 = Cubic Meter
[2] Assume Stockpile is 10 Meters Deep
[3] Conversion Factor: Grams*0.0000011023 = Ton

[a] Based on March 5, 2010, equipment list spreadsheet (equipmentjfrMarch 5.xls)
[b] Based on June 15, 2010, email attachment from Jane Rinck to Garrett Smith and Leroy Shaser (commentary.docx)

FUGITIVE DUST Emissions: Concrete Batch Plant

Methodology and Assumptions from AP-42 , Fifth Edition, Volume 1 Chapter 11.12: Concrete Batching

Emission Factors from AP-42 11.12 Concrete Batching

PM_{10} emissions in pounds per ton of concrete:

Batch Plant Source	Uncontrolled	Controlled
Aggregate transfer	0.0033	ND
Sand transfer	0.00099	ND
Cement unloading to elevated storage silo (pneumatic)	0.46	0.00034
Cement supplement unloading to elevated storage silo (pneumatic)	1.10	0.0049
Weigh hopper loading	0.0024	ND
Mixer loading (central mix)	0.134	0.0048
Truck loading (truck mix)	0.278	0.016
Total	1.98	0.033

Note: Controlled Total is calculated by adding data from "Controlled" column with data from "Uncontrolled" column when "Controlled" is ND.

One cubic yard of concrete (lbs) 4,024

ND = No Data
cy = cubic yards

Fugitive Dust Emission Calculations for Control Structure

Period of Batch Plant Operation (months):	24
Aggregate (cy)	97,000
Concrete Placement (cy)[1]:	97,234
Concrete Placement (tons):	195,635

Parameter	Annual Concrete Placement (tons)	Unmitigated emissions (pounds/year)	Controlled emissions (pounds/year)	Unmitigated emissions (tons/year)	Controlled emissions (tons/year)
PM_{10}	97,817	193,550	3,202	97	1.6

[1] Based on Project Description

Fugitive Dust Emission Calculations for Chute and Stilling Basin

Period of Batch Plant Operation (months):	36
Aggregate (cy)	211,068
Concrete Placement -Chute (cy):	99,625
Concrete Placement -Stilling Basin (cy):	28,295
Concrete Placement -Total (cy):	127,920
Concrete Placement (tons):	257,375

Parameter	Annual Concrete Placement (tons)	Unmitigated emissions (pounds/year)	Controlled emissions (pounds/year)	Unmitigated emissions (tons/year)	Controlled emissions (tons/year)
PM_{10}	85,792	169,755	2,808	84.9	1.4

Urbemis 2007 Version 9.2.4

Detail Report for Annual Construction Unmitigated Emissions (Tons/Year)

File Name: F:\I-drive\G018 Sacramento\Workfiles\Urbemis\Folsom_Control_Structure1_06-11-10.urb924

Project Name: Folsom Dam Control Structure Excavation

Project Location: Sacramento County AQMD

On-Road Vehicle Emissions Based on: Version : Emfac2007 V2.3 Nov 1 2006

Off-Road Vehicle Emissions Based on: OFFROAD2007

CONSTRUCTION EMISSION ESTIMATES (Annual Tons Per Year, Unmitigated)

	ROG	NOx	CO	SO2	PM10 Dust	PM10 Exhaust	PM10 Total	PM2.5 Dust	PM2.5 Exhaust	PM2.5 Total	CO2
2011	0.00	0.00	0.00	0.00	18.36	0.00	18.36	3.83	0.00	3.83	0.00
Mass Grading 01/17/2011-	0.00	0.00	0.00	0.00	18.36	0.00	18.36	3.83	0.00	3.83	0.00
Mass Grading Dust	0.00	0.00	0.00	0.00	18.36	0.00	18.36	3.83	0.00	3.83	0.00
Mass Grading Off Road Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mass Grading On Road Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Mass Grading Worker Trips	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Phase Assumptions

Phase: Mass Grading 1/17/2011 - 9/16/2011 - Folsom Dam Control Structure Excavation

Total Acres Disturbed: 0

Maximum Daily Acreage Disturbed: 0

Fugitive Dust Level of Detail: Low

Onsite Cut/Fill: 1777.78 cubic yards/day; Offsite Cut/Fill: 0 cubic yards/day

On Road Truck Travel (VMT): 0

Off-Road Equipment:

FUGITIVE DUST Emissions: Blasting and Associated Drilling

Blasting Methodology from Blue Rock Quarry Draft Environmental Impact Report (Sonoma County 2005)

Equation:

$EF = 0.2 * 961 (A)^{0.8} / [(D)^{1.8} (M)^{1.9}]$

Where:

EF = Emission Factor
A= Blast Area
D= Depth of Blast
M= Moisture Content

Two blast sizes would be used during excavation: 50% of excavation with a blast volume of 2,778 cubic yards and 50% of excavation with a blast volume of 1,389 cubic yards. Assume 300,000 total cubic yards of excavation.

Information: Blasting dimensions provided by Kim Jorgensen in email to Garrett Smith (March 18, 2010)

Blast size #1 (2,778 cubic yards)

Cubic yards: 150,012

Fugitive Dust from Blast

Depth of Blast (ft)	20	Depth of approximately 20 feet
Moisture content of material (%)	2	Moisture content from (Corps 2009) Appendix A: Blasting Emissions
Blast Area (sq ft)	3,750	Assumes 75 feet wide (wall) by 50 feet burden
Number of blasts:	54	
Number of holes per blast:	150	Total number of holes: 8,100
Emission Factor=	169.50	pounds per blast
Total Emissions (lbs)	9,152.95	PM_{10}
Total Emissions (tons)	4.58	PM_{10}

Fugitive Dust from Drilling

Emission factor (lbs/hole)	1.3	TSP: Methodology from AP-42, Table 11.9-4
Total Emissions (lbs)	10,530.0	TSP
Total Emissions (tons)	5.27	TSP (Most Conservative Assumption: Assume 100% TSP is PM_{10})

Blast size #2 (1,389cubic yards)

Cubic yards: 150,012

Fugitive Dust from Blast

Depth of Blast (ft)	20	Depth of approximately 20 feet
Moisture content of material (%)	2	Moisture content from (Corps 2009) Appendix A: Blasting Emissions
Blast Area (sq ft)	1,875	Assumes 75 feet wide (wall) by 25 feet burden
Number of blasts:	108	
Number of holes per blast:	75	Total number of holes: 8,100
Emission Factor=	97.35	pounds per blast
Total Emissions (lbs)	10,513.98	PM_{10}
Total Emissions (tons)	5.26	PM_{10}

Fugitive Dust from Drilling

Emission factor (lbs/hole)	1.3	TSP: Methodology from AP-42, Table 11.9-4
Total Emissions (lbs)	10,530.0	TSP
Total Emissions (tons)	5.27	TSP (Most Conservative Assumption: Assume 100% TSP is PM_{10})

Totals

Unmitigated Total PM_{10} from Blasting (tons)	9.83	
Mitigated Total PM_{10} from Blasting(tons)	6.3	Assume 36% control efficiency (Folsom Dam Safety and Flood Damage Reduction Early Approach Channel Excavation Final EA/IS (Corps 2009))
Unmitigated Total PM_{10} from Drilling (tons)	10.53	
Mitigated Total PM_{10} from Drilling (tons)	4.7	Assume 55% reduction from soil disturbance activities (SMAQMD, 2009))
Unmitigated Total PM_{10} from Blasting and Drilling (tons)	20.36	
Mitigated Total PM_{10} from Blasting and Drilling (tons)	11.03	

GHG Emissions - Cumulative Summary from all Activities

Unmitigated Carbon Dioxide Emissions

Borings for Approach Channel Cofferdam

(Oct 2010 through Jan 2011)
Period of Operation (months) 4

Worker Commute Emissions

	CO_2	
	Average annual tons	Average annual metric tons
	8.9	8.1

Construction Equipment Exhaust

	CO_2	
	Average annual tons	Average annual metric tons
	56	51
Summation	65	59

Control Structure

(Jan 2011 through July 2014)
Period of Operation (months) 42

Worker Commute Emissions (Both Excavation and Concrete Emplacement)

	CO_2	
	Average annual tons	Average annual metric tons
	195	177

Construction Equipment Exhaust

	CO_2	
	Average annual tons	Average annual metric tons
Excavation	3,382	3,068
Concrete Placement and Batch Plant	1,064	965
Gate Installation	90	81

On-Site Haul Truck

	CO_2	
	Average annual tons	Average annual metric tons
Excavation	53	48

Off-Site Haul Truck

	CO_2	
	Average annual tons	Average annual metric tons
	280	254

Concrete Batch Plant

	CO_2	
	Average annual tons	Average annual metric tons
	13,111	11,895
Summation: Maximum average annual emissions	17,021	15,441

Value calculated using Control Structure Excavation CO_2 emissions for construction equipment exhaust.

Chute and Stilling Basin

(late 2013 through 2016)
Period of Operation (months) 36

Worker Commute Emissions

	CO_2	
	Average annual tons	Average annual metric tons
	195	177

Construction Equipment Exhaust

	CO_2	
	Average annual tons	Average annual metric tons
	2,591	2,351

Off-Site Haul Truck

	CO_2	
	Average annual tons	Average annual metric tons
	332	301

Concrete Batch Plant

	CO_2	
	Average annual tons	Average annual metric tons
	11,499	10,432
Summation	14,617	13,260

Carbon dioxide emission values derived from other calculation spreadsheets and copied to this summary sheet.

GHG Emissions: Concrete Batch Plant

Emission Factor from Flowers and Sanjayan, 2007 (Abstract): "Green House Gas Emissions Due to Concrete Manufacture,
The International Journal of Life Cycle Assessment. Vol 12, Number 5, July 2007. Landsberg, Germany: Ecomed.

CO_2 emissions in kilograms per cubic meter of concrete:	320
CO_2 emissions in kilograms per cubic yard of concrete:	244.7
CO_2 emissions in kilograms per ton of concrete:	121.6

To convert cubic meter to cubic yard (multiply by):	1.3079
To convert cubic yard to cubic meter (multiply by):	0.76456
One cubic yard of concrete (lbs)	4,024

cy = cubic yards

Carbon Dioxide Emission Calculations for Control Structure

Period of Batch Plant Operation (months):	24
Aggregate (cy)	97,000
Concrete Placement (cy)[1]:	97,234
Concrete Placement (tons):	195,635

Parameter	Annual Concrete Placement (tons)	Emission Factor (kg/ton)	CO_2 emissions (kg/year)	CO_2 emissions (metric tons/year)	CO_2 emissions (tons/year)
CO_2	97,817	121.6	11,894,596	11,895	13,111

[1] Based on Project Description

Carbon Dioxide Emission Calculations for Chute and Stilling Basin

Period of Batch Plant Operation (months):	36
Aggregate (cy)	211,068
Concrete Placement -Chute (cy):	99,625
Concrete Placement -Stilling Basin (cy):	28,295
Concrete Placement -Total (cy)[2]:	127,920
Concrete Placement (tons):	257,375

Parameter	Annual Concrete Placement (tons)	Emission Factor (kg/ton)	CO_2 emissions (kg/year)	CO_2 emissions (metric tons/year)	CO_2 emissions (tons/year)
CO_2	85,792	121.6	10,432,268	10,432	11,499

[2] Based on June 15, 2010, email attachment from Jane Rinck to Garrett Smith and Leroy Shaser (commentary.docx).

GHG Emissions - Construction Equipment Exhaust

Equipment

Type	Number	Hours per day	Days per week	Months		Hours per week	Hours per Project	Calculated 8-hour days per Project	CO_2 Emission Factor (g/hr)	Unmitigated Emissions (grams) CO_2	Total Unmitigated CO_2 Emissions Kilograms	Total Unmitigated CO_2 Emissions Metric Tons	Total Unmitigated CO_2 Emissions Tons	**Unmitigated Estimated Annual Emissions*** Kilograms	**Unmitigated Estimated Annual Emissions*** Metric Tons	**Unmitigated Estimated Annual Emissions*** Tons
CONTROL STRUCTURE - Concrete Placement and Batch Plant			**24 Months**			July 2011 through July 2013								*Assume emissions spread out over 24 months		
Semi-trailer truck	20	4	5	12		400	19,200	2,400		Off-site Haul Truck calculations						
Belly dump truck	8	4	3	16		96	6,144	768		Off-site Haul Truck calculations						
Tanker trucks	2	4	3	16		24	1,536	192		Off-site Haul Truck calculations						
Chiller	1	10	5	12		50	2,400	300	115,321	276,769,560	276,770	276.77	305.08	138,385	138	153
Stationary Cranes - electric	2	8	5	12		80	3,840	480	0	0	0	0	0	0	0	0
Forklifts	2	4	5	12		40	1,920	240	116,379	223,447,085	223,447	223.45	246.31	111,724	112	123
Man lift/scissor lift - electric	2	8	5	12		80	3,840	480	0	0	0	0	0	0	0	0
Water truck	1	4	5	12		20	960	120	283,370	272,035,238	272,035	272.04	299.86	136,018	136	150
Street sweeper	1	8	1	12		8	384	48	115,321	44,283,130	44,283	44.28	48.81	22,142	22	24
Jackhammers	2	8	1	12		16	768	96	115,321	88,566,259	88,566	88.57	97.63	44,283	44	49
Cement mixers (transit)	0	4	5	12		0	0	0	115,321	0	0	0.00	0.00	0	0	0
Front end loaders	2	8	5	8		80	2,560	320	23,463	60,066,381	60,066	60.07	66.21	30,033	30	33
Flatbed delivery truck	1		5							Off-site Haul Truck calculations						
Control Structure Concrete Placement Emissions											965,168	965	1,064	482,584	483	532
CONTROL STRUCTURE - Excavation (9 months)			Jan - Sept 2011													
"Super" dump trucks	5	8	5	6		200	4,800	600		On-site Haul Truck calculations						
Water trucks	1	4	5	6		20	480	60	283,370	136,017,619	136,018	136.02	149.93	136,018	136	150
Fuel truck	1	2	5	8		10	320	40	115,321	36,902,608	36,903	36.90	40.68	36,903	37	41
Maintenance truck	4	4	5	8		80	2,560	320	115,321	295,220,864	295,221	295.22	325.42	295,221	295	325
Pickup trucks	10	4	5	8		200	6,400	800	115,321	738,052,160	738,052	738.05	813.55	738,052	738	814
Drills for grouting - electric	6	8	5	9		240	8,640	1,080	0	0	0	0.00	0.00	0	0	0
Rock drills for setting charges	NE	NE	NE	NE	NE	NE	7,353	919	63,991	470,527,220	470,527	470.53	518.66	470,527	471	519
Front end loaders	2	8	5	8		80	2,560	320	23,463	60,066,381	60,066	60.07	66.21	60,066	60	66
Dozers with rippers	2	8	5	8		80	2,560	320	210,778	539,592,653	539,593	539.59	594.79	539,593	540	595
Backhoes	4	8	5	8		160	5,120	640	23,463	120,132,762	120,133	120.13	132.42	120,133	120	132
Graders	2	8	5	8		80	2,560	320	104,092	266,476,442	266,476	266.48	293.74	266,476	266	294
Scrapers	3	8	5	3		120	1,440	180	145,798	209,948,472	209,948	209.95	231.43	209,948	210	231
Excavators	2	8	5	5		80	1,600	200	106,021	169,632,960	169,633	169.63	186.99	169,633	170	187
Compactor sheep foot	2	8	5	3		80	960	120	26,757	25,686,566	25,687	25.69	28.31	25,687	26	28
		NE = Not Estimated														
Control Structure Excavation Emissions											3,068,257	3,068	3,382	3,068,257	3,068	3,382
CONTROL STRUCTURE - Gate Installation (9 months)			December 2013 through July 2014													
Track driven cranes	2	8	5	5		80	1,600	200	50,874	81,399,088	81,399	81.40	89.73	81,399	81	90
Flat bed trucks										Off-site Haul Truck calculations						
Control Structure Gate Installation Emissions											81,399	81	90	81,399	81	90
CHUTE AND STILLING BASIN - Concrete Placement and Batch Plant (36 months)					Late 2013 through 2016											
Semi-trailer truck	20	4	5	36		400	57,600	7,200		Off-site Haul Truck calculations						
Belly dump truck	8	4	3	36		96	13,824	1,728		Off-site Haul Truck calculations						
Tanker trucks	2	4	3	36		24	3,456	432	115,321	398,548,166	398,548	398.55	439.32	132,849	133	146
Chiller	1	10	5	36		50	7,200	900	115,321	830,308,680	830,309	830.31	915.25	276,770	277	305
Stationary Cranes - electric	2	8	5	36		80	11,520	1,440	0	0	0	0.00	0.00	0	0	0
Forklifts	2	4	5	36		40	5,760	720	116,379	670,341,254	670,341	670.34	738.92	223,447	223	246
Man lift/scissor lift - electric	2	8	5	36		80	11,520	1,440	0	0	0	0.00	0.00	0	0	0
Water truck	1	4	5	36		20	2,880	360	283,370	816,105,715	816,106	816.11	899.59	272,035	272	300
Street sweeper	1	8	1	36		8	1,152	144	115,321	132,849,389	132,849	132.85	146.44	44,283	44	49
Jackhammers	2	8	1	36		16	2,304	288	115,321	265,698,778	265,699	265.70	292.88	88,566	89	98
Cement mixers (transit)	0	4	5	36		0	0	0	115,321	0	0	0.00	0.00	0	0	0
Front end loaders	2	8	5	36		80	11,520	1,440	23,463	270,298,714	270,299	270.30	297.95	90,100	90	99
Flatbed delivery truck	1		5							Off-site Haul Truck calculations						
CHUTE AND STILLING BASIN - Foundation Preparation/Backfill (36 months)					Late 2013 through 2016											
Fuel truck	1	2	5	36		10	1,440	180	115,321	166,061,736	166,062	166.06	183.05	55,354	55	61
Water truck	1	4	5	36		20	2,880	360	283,370	816,105,715	816,106	816.11	899.59	272,035	272	300
Front end loader	1	4	5	36		20	2,880	360	23,463	67,574,678	67,575	67.57	74.49	22,525	23	25
Pickup trucks	5	4	5	36		100	14,400	1,800	115,321	1,660,617,360	1,660,617	1,660.62	1,830.50	553,539	554	610
Track driven cranes	2	4	5	24		40	3,840	480	50,874	195,357,811	195,358	195.36	215.34	97,679	98	108
Drills for grouting - electric	6	8	5	24		240	23,040	2,880	0	0	0	0.00	0.00	0	0	0
Portable cement mixers	2	4	5	12		40	1,920	240	115,321	221,415,648	221,416	221.42	244.07	221,416	221	244
Chute and Stilling Basin Emissions											6,511,284	6,511	7,177	2,350,598	2,351	2,591
BORINGS FOR APPROACH CHANNEL COFFERDAM (4 months)				Late 2010 - Early 2011												
Diesel & Hydraulic drill rig	1	10	5	4		50	800	100	63,991	51,192,952	51,193	51.19	56.43	51,193	51	56
Flat bed trucks	2	4	5	4						Off-site Haul Truck calculations						
Borings for Approach Channel Emissions											51,193	51	56	51,193	51	56
										TOTAL EMISSIONS	10,677,300.0	10,677.3	11,769.6			

Construction Equipment GHG Emission Rate (grams per hour) from Corps 2009

Equipment Type (2009)	Max HP	CO_2	
Bore/Drill Rigs	175	63,991.19	Project will use 140 hp drills
Paving Equipment	250	55,470.42	
Rollers	120	26,756.84	
Cranes	250	50,874.43	
Crawler Tractors	750	210,778.38	
Crushing/Proc Equipment	750	267,090.67	
Rough Terrain Forklifts	500	116,378.69	
Rubber Tired Dozers	750	180,887.50	
Rubber Tired Loaders	750	220,232.06	
Excavators	500	106,020.60	
Graders	500	104,092.36	
Off-Highway Tractors/Compactors	750	257,699.59	
Scrapers	500	145,797.55	
Skid Steer Loaders	120	19,396.44	
Off-Highway Trucks/Water Trucks	1,000	283,370.04	
Other Construction Equipment	500	115,320.65	
Pavers	500	105,798.73	
Surfacing Equipment	750	157,418.36	
Tractors/Loaders/Backhoes	120	23,463.43	
Trenchers	500	141,207.16	

Emission factors for CO_2 from (Corps 2009)

Appendix F –

Noise Analysis

Joint Federal Project (JFP) at Folsom Dam, Approach Channel Excavation

Noise Technical Memorandum

Sacramento, CA

Draft

February 2012

U.S Army Corps of Engineers, Sacramento District

U.S. Army Corps of Engineers
Sacramento District

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List of Abbreviations and Acronyms

ADT	Average Daily Traffic
ANSI	American National Standards Institute
Bio-x	Bio measurement site x (x = site number)
BNoise	Blast Noise
CadnaA	Computer-Aided Noise Abatement
CEQA	California Environmental Quality Act
Cfm	Cubic Feet per Minute
CFR	Code of Federal Regulations
CNEL	Community Noise Equivalent Level
cy	Cubic yard
dB	decibels
dB(A)	decibel – A-Weighted
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
FHWA	Federal Highway Administration
FTA	Federal Transit Administration
ISO	International Standard of Organization
Hz	hertz
JFP	Joint Federal Project
kHz	kilohertz
Ldn	day-night sound level
Leq	equivalent sound level
Lmax	maximum sound level
Lmin	minimum sound level
LORS	laws, ordinances, regulations and standards
Lxx	percentile-exceeded sound level
LT-x	long term measurement site x (x = site number)
MIAD	Mormon Island Auxiliary Dam
µPa	micro-Pascals
mph	miles per hour
MR-x	Modeled Receiver x (x = site number)
NAC	noise abatement criteria
NOAA	National Oceanic and Atmospheric Administration

List of Abbreviations and Acronyms (Con't)

NSR	Noise Study Report
OSHA	Occupational Safety and Health Administration
PWL	Sound Power Level
RCNM	Road Construction Noise Model
RMS	root-mean-square
ROD	Record of Decision
SEL	Sound exposure level
SPL	sound pressure level
ST-x	short term measurement site x (x = site number)
NAVD	North American Vertical Datum
TNM	Traffic Noise Model
USBR	United States Bureau of Reclamation
USDOT	US Department of Transportation
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

1.0 SETTINGS/AFFECTED ENVIRONMENT

1.1 Background

As part of the Folsom Dam Safety and Flood Damage Reduction Project, also referred to as the Joint Federal Project (JFP), an auxiliary spillway is under construction jointly by the U.S. Bureau of Reclamation (USBR) and the U.S. Army Corps of Engineers (USACE). The JFP is intended to provide increased flood damage reduction and mitigate dam safety issues related to a Probable Maximum Flood event. The new auxiliary spillway would be operated in concert with the existing spillway gates and river outlets on Folsom Dam to manage flood flows from Folsom Reservoir.

The final phase of the proposed project is the completion of the approach channel and spur dike. A trans-load facility and concrete batch plant are necessary for construction to be completed. The project would be phased such that maximum excavation of the approach channel, and construction of the spur dike, can be completed during low lake levels in the dry, to minimize both project costs and water quality and biological impacts. There are currently three potential alternatives for the proposed project: Alternative 1, Alternative 2 and Alternative 3. Alternative 1 is the no project Alternative. Alternative 2 includes approach channel excavation with the utilization of a cutoff wall while Alternative 3 includes approach channel excavation with the utilization of a cofferdam.

1.2 Purpose and Scope

This section presents the results of a noise impact analysis for the Folsom Dam JFP and includes relevant noise laws, ordinances, and regulations, the results of a noise survey, and a quantitative analysis of noise environmental impacts during project activities. The analysis includes:

- Discussion of source terrestrial noise emissions from construction schedules and activities such as excavation, blasting, construction of the spur dike, material delivery, batch plant utilization and utilization of the on-site haul road
- Descriptions of the affected environment including identification of human and wildlife sensitive receptors
- Development and use of appropriate air and noise quantification models
- Potential noise impacts
- Qualitative discussion on impacts due to underwater excavation and blasting activities
- Mitigation measures
- Cumulative effects

1.3 Project Components Analyzed for Noise Impacts

The project involves the following aspects depending on whether Alternative 2 or 3 is chosen: approach channel excavation, spur dike construction, transload facility construction, batch plant operations, cutoff wall construction and cofferdam construction.

Approach Channel Excavation

The approach channel for the auxiliary spillway extends approximately 1,100 feet upstream of the concrete control structure. The approach channel converges as it approaches the control structure. The approach slab is a 5-foot thick, reinforced concrete slab that extends approximately 150 feet upstream of the control structure. The approach channel excavation includes excavation of rock material within the envelope of the approach channel, shaping and scaling of the channel surfaces, excavation of any rock trap recesses in the floor of the channel, placement of the approach slab, armoring of any side slopes susceptible to erosion. Excavation would occur both in-the-dry and in-the-wet.

An estimated volume of 932,500cy of material would be excavated for the approach channel. A portion of the approach channel excavation would be executed using land based techniques above the seasonal low water pool. The remainder of the approach channel would be excavated from barge mounted equipment.

Land based rock excavation would be accomplished with conventional drilling and blasting methods and rock excavation underwater would be accomplished by drill and blast methods (URS, 2009). In dry holes, ANFO (ammonium nitrate-fuel oil) would be utilized and primed with cast boosters. Blasting would typically consist of approximately 15,000 cubic yards rock shots. Rock excavation under water would be accomplished by drill and blast methods (URS, 2009). Each blast would produce approximately 2,000 cubic yards of rock. Water-resistant emulsified slurry would be required since water intrusion is anticipated. Explosives would be stored off-site. The explosives storage facility is assumed to be located in Jamestown, California, approximately 80 miles from the site. Explosives would be trucked to the site on a daily basis.

To limit the blast over-pressures, all charges would be confined by rock burden and crushed stone stemming in amounts that are at least 20-charge diameters. A bubble curtain would reduce the blast-induced dynamic water pressure that could be transmitted to the lake.

Spur Dike Construction

A spur dike is an embankment designed to direct water into an opening; in this case the opening would be the approach channel. The proposed elliptical-shaped spur dike would be located directly to the northwest of the approach channel. The core of the spur dike would be constructed of a decomposed quartz diorite core, commonly known as decomposed granite. This would be followed by a compacted random rock fill followed by a stone riprap cap. The quantity of material estimated to complete the spur dike is 395,000 cy. Material for the spur dike construction would come from the excavation of the approach channel excavation, or Mormon Island Auxiliary Dam (MIAD) disposal area. The construction equipment needed to build the spur dike consists of normal scrapers, bulldozers, and sheep-foot rollers for the body of the spur dike, and backhoes, bulldozers, and smooth rollers for the bedding, riprap, and surfacing materials. The construction would take place over 9 months in 2016 and 2017.

Transload Facility Construction

A transload facility would be needed for mobilization/demobilization of marine equipment (e.g., sectional barges and heavy cranes), dredge spoil off-loading from barges to trucks, marine equipment fuel and explosives transfer to support barges, equipment maintenance, and marine crew deployment. The proposed trans-load facility would be comprised of a ramp, crane and crane pad, and a fuel transfer station. The transload facility would be located adjacent to Dike 7. The transload facility is temporary and would be removed after the completion of the approach channel project in 2017. Ramp material would be removed with excavators and hauled for disposal at the MIAD disposal area.

Batch Plant and Staging Area Operations

Definitive uses of each staging area have not been determined. The four locations for the staging areas are the Folsom Prison staging area, MIAD staging area, Overlook staging area and Dike 7 staging area. The construction of the approach channel and cutoff wall would require large quantities of temperature controlled concrete. This would necessitate the use of a contractor-provided, on-site concrete batch plant and deliveries of large quantities of concrete aggregate, concrete sand, and cement. The batch plant would be powered by electricity from overhead Sacramento Municipal Utility District lines.

Cutoff Wall Construction

A cutoff wall is proposed for Alternative 2. The proposed cutoff wall would be located adjacent to Folsom Lake southeast of the Left Wing Dam and east of the Auxiliary Spillway chute excavation. The cutoff wall would consist of a reinforced concrete secant pile wall installed across the width of the future approach channel. The total length of the wall would be approximately 1,000 feet. The wall would be socketed into the underlying highly weathered granitic rock.

The secant wall would be constructed by initially drilling 3-foot diameter holes for the primary piles on 4-foot centers. After the drilling, the hole would be filled with concrete and a reinforcing cage. The top section of the piles would be drilled with a steel casting used to support the layers of cobbles and boulders. The bottom section of the pile that penetrates the decomposed and highly weathered granite would not require casing. The casing would be removed as concrete is placed in the hole. The average pile length is estimated to be 85 ft.

Three-foot diameter holes for the secondary piles would then be drilled on 4-foot centers between the primary piles. The secondary piles would be reinforced and constructed with concrete and a reinforcing cage. Both primary and secondary piles would be filled with concrete. No impact or vibratory pile driving is anticipated under this alternative (Mike Forrest, pers com to R. Verity, Jan 3 2012).

Cofferdam Construction

A cofferdam is proposed for Alternative 3. The cofferdam consists of a series of 84-foot diameter circular sheet pile cells constructed using 85-foot-long flat sheet piles.

The construction of the cells requires sheet piles to be installed using a template. The template consists of two to three horizontally mounted ring wales provide support for the vertical flat sheets. The sheet piles are installed using a vibratory hammer, working progressively around the ring. Once erected, the cells would be filled with well-graded crushed rock. The same plan dimension is maintained throughout the cofferdam, allowing for one sheet pile installation template to be utilized for construction of all of the circular cells. A layer of riprap would be placed along the upstream toe of the cells for scour protection. The cells are founded directly on the decomposed granite. The cofferdam accommodates a high design lake level of elevation 468 feet.

The cofferdam would have a provision for controlled but rapid flooding of the approach channel area to allow for quick equalization of hydraulic loads on both sides of the cofferdam. Rapid flooding of the approach channel excavation would be achieved by two or more flood gates installed in the connector cells. Each gate would consist of an approximately 100-foot-long, 4-foot diameter pipe mounted with a slide gate on the upstream side of the cofferdam. Accounting for energy losses at the inlet, outlet, and friction along the pipe walls and at the slide gate, two pipes would allow for infilling of the approach channel excavation area up to the high lake level at elevation 468.34 feet within about 6 hours.

Prior to cofferdam construction, lake sediments and other soils would be dredged to expose decomposed granite. A silt curtain placed around the perimeter of the excavation will be required to control turbidity in the lake. The total estimated volume of cofferdam fill materials would be 149,600 cy, almost all of which is cell fill.

Potential noise impacts were assessed at noise-sensitive human and wildlife receptors within the vicinity of the proposed project. Project activities that were assessed include: approach channel excavation and spur dike construction activities, blasting and traffic. A qualitative discussion of potential negative effects on fish species residing in Folsom Lake in the vicinity of underwater approach channel excavation and blasting activities will be developed. Potential noise-sensitive human receptors within the City of Folsom, Sacramento County, Placer County and El Dorado County were considered. Potential noise-sensitive wildlife is assessed within a five-mile radius of the proposed approach channel excavation and spur dike construction area.

1.4 Fundamentals of Acoustics

Noise is generally defined as loud, unpleasant, unexpected, or undesired sound that is typically associated with human activity and interferes with or disrupts normal activities. Although exposure to high noise levels has been demonstrated to cause hearing loss, the principal human response to typical environmental noise exposure levels is annoyance. The responses of individuals to similar noise events are diverse and influenced by many factors including the type of noise, the perceived importance of the noise, its appropriateness to the setting, the time of day and the type of activity during which the noise occurs, and noise sensitivity of the individual.

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air, which are sensed by the human ear. Sound is generally characterized by several variables, including frequency and amplitude. Frequency describes the sound's pitch (tone) and is measured in cycles per second (Hertz [Hz]), while amplitude describes the sound's pressure (loudness). Because the range of sound pressures that occur in the environment is extremely large, it is convenient to express these pressures on a logarithmic scale that compresses the wide range of pressures into a more useful range of numbers. The standard unit of sound measurement is the decibel (dB).

Hz is a measure of how many times each second the crest of a sound pressure wave passes a fixed point. For example, when a drummer beats a drum, the skin of the drum vibrates a number of times per second. When the drum skin vibrates 100 times per second it generates a sound pressure wave that is oscillating at 100 Hz, and is perceived by the ear/brain as a tonal pitch of 100 Hz. Sound frequencies between 20 and 20,000 Hz are within the range of sensitivity of the healthy human ear.

Sound level is expressed by reference to a specified national/international standard. The Sound Pressure Level (SPL) is used to describe sound at a specified distance or specific receptor location. In expressing sound pressure level on a logarithmic scale, sound pressure is compared to a reference value of 20 micropascals (µPa). SPL depends not only on the power of the source, but also on the distance from the source and on the acoustical characteristics of the space surrounding the source (absorption, reflection, etc.).

Outdoor sound levels decrease logarithmically as the distance from the source increases. This is due to wave divergence, atmospheric absorption, and ground attenuation. Sound radiating from a source in a homogeneous and undisturbed manner travels in spherical waves. As the sound waves travel away from the source, the sound energy is dispersed over a greater area decreasing the sound pressure of the wave. Spherical spreading of the sound wave from a point source reduces the noise level at a rate of 6 dB per doubling of distance.

Atmospheric absorption also influences the sound levels received by an observer. The greater the distance traveled, the greater the influence of the atmosphere and the resultant fluctuations. Atmospheric absorption becomes important at distances greater than 1,000 feet. The degree of absorption varies depending on the frequency of the sound as well as the humidity and temperature of the air. For example, atmospheric absorption is lowest (i.e., sound carries further) at high humidity and high temperatures and lower frequencies are less readily absorbed (i.e., sound carries further) than higher frequencies. Over long distances, lower frequencies become dominant as the higher frequencies are more rapidly attenuated. Turbulence, gradients of wind and other atmospheric phenomena also play a significant role in determining the degree of attenuation. For example, certain conditions, such as temperature inversions can channel or focus the sound waves resulting in higher noise levels than would result from simple spherical spreading.

Most sounds one hears consist of a broad band of many frequencies differing in sound level. Because of the broad range of audible frequencies, methods have been developed to quantify these values into a single number. The most common method used to quantify environmental sounds uses a weighting system that is reflective of human hearing. Human hearing is less sensitive at low frequencies and extremely high frequencies than at the mid-range frequencies. This process is termed “A weighting”, and the resulting dB level is termed the “A weighted” decibel (dBA). “A weighting" is widely used in local noise ordinances and state and federal guidelines. In practice, the level of a noise source is conveniently measured using a sound level meter that includes a filter corresponding to the dBA curve. Unless specifically noted, the use of A weighting is always assumed with respect to environmental sound and community noise even if the notation does not show the “A”. Sound levels underwater are not weighted and measure the entire frequency range of interest.

A sound level of 0 dBA is approximately the threshold of human hearing and is barely audible by a healthy ear under extremely quiet listening conditions. This threshold is the reference level against which the amplitude of other sounds is compared. Normal speech has a sound level of approximately 60 dBA. Sound levels above about 120 dBA begin to be felt inside the human ear as discomfort, progressing to pain at higher levels. An increase (or decrease) in sound level of about 10 dBA is usually perceived by the average person as a doubling (or halving) of the sound’s loudness.

Because of the logarithmic nature of the dB unit, sound levels cannot be added or subtracted directly and are somewhat cumbersome to handle mathematically. However, some simple rules are useful in dealing with sound levels. First, if a sound’s intensity is doubled, the sound level increases by 3 dB, regardless of the initial sound level. Thus, for example: 60 dB + 60 dB = 63 dB, and 80 dB + 80 dB = 83 dB. Remember however, that it requires about a 10 dB increase to double the perceived intensity of a sound and it is interesting to note that a doubling of the acoustical energy (a 3 dB increase) is at the lower limit of readily perceived change.

Although dBA may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously. Most ambient environmental noise includes a mixture of noise from nearby and distant sources that creates an ebb and flow of sound including some identifiable sources plus a relatively steady background noise in which no particular source is identifiable. A single descriptor called the equivalent sound level (L_{eq}) is used to describe sound that is constant or changing in level. L_{eq} is the energy-mean dBA during a measured time interval. It is the “equivalent” constant sound level that would have to be produced by a given constant source to equal the acoustic energy contained in the fluctuating sound level measured during the interval. In addition to the energy-average level, it is often desirable to know the acoustic range of the noise source being measured. This is accomplished through the maximum L_{eq} (L_{max}) and minimum L_{eq} (L_{min}) indicators that represent the root-mean-square (RMS) maximum and minimum noise levels measured during the monitoring interval. The L_{min} value obtained for a particular monitoring location is often called the acoustic floor for that location.

To describe the time-varying character of environmental noise, the statistical or percentile noise descriptors L_{10}, L_{50}, and L_{90} may be used. These are the noise levels equaled or exceeded during 10 percent, 50 percent, and 90 percent of the measured time interval. Sound levels associated with L_{10} typically describe transient or short-term events. L_{50} represents the median sound level during the measurement interval, while L_{90} levels are typically used to describe background noise conditions.

The Day-Night Average Sound Level (L_{dn} or DNL) represents the average sound level for a 24-hour day and is calculated by adding a 10 dB penalty only to sound levels during the night period (10:00 p.m. to 7:00 a.m.). The L_{dn} is the descriptor of choice used by nearly all federal, state, and local agencies throughout the United States to define acceptable land use compatibility with respect to noise. Within the State of California, the Community Noise Equivalent Level (CNEL) is sometimes used. CNEL is very similar to L_{dn}, except that an additional 5 dB penalty is applied to the evening hours (7:00 p.m. to 10:00 p.m.). Because of the time-of-day penalties associated with the L_{dn} and CNEL descriptors, the L_{dn} or CNEL dBA value for a continuously operating sound source during a 24-hour period will be numerically greater than the dBA value of the 24-hour L_{eq}. Thus, for a continuously operating noise source producing a constant noise level operating for periods of 24 hours or more, the L_{dn} will be 6 dB higher than the 24-hour L_{eq} value. To provide a frame of reference, common sound levels are presented in Table 1, “Sound Levels of Typical Noise Sources and Noise Environments”.

Table 1: Sound Levels of Typical Noise Sources and Noise Environments (A-Weighted Sound Levels)

Noise Source (at Given Distance)	Scale of A-Weighted Sound Level in Decibels	Noise Environment	Human Judgment of Noise Loudness (Relative to a Reference Loudness of 70 Decibels*)
Military Jet Take-off with After-burner (50 ft)	140	Carrier Flight Deck	–
Civil Defense Siren (100 ft)	130	–	–
Commercial Jet Take-off (200 ft)	120	–	**Threshold of Pain** *32 times as loud
Pile Driver (50 ft)	110	Rock Music Concert	*16 times as loud
Ambulance Siren (100 ft) Newspaper Press (5 ft) Power Lawn Mower (3 ft)	100		**Very Loud** *8 times as loud
Propeller Plane Flyover (1,000 ft) Diesel Truck, 40 mph (50 ft) Motorcycle (25 ft)	90	Boiler Room Printing Press Plant	*4 times as loud
Garbage Disposal (3 ft)	80	High Urban Ambient Sound	*2 times as loud

Table 1: Sound Levels of Typical Noise Sources and Noise Environments (A-Weighted Sound Levels)

Noise Source (at Given Distance)	Scale of A-Weighted Sound Level in Decibels	Noise Environment	Human Judgment of Noise Loudness (Relative to a Reference Loudness of 70 Decibels*)
Passenger Car, 65 mph (25 ft) Living Room Stereo (15 ft) Vacuum Cleaner (3 ft)	70	–	**Moderately Loud** *70 decibels (Reference Loudness)
Air Conditioning Unit (100 ft) Normal Conversation (5 ft)	60	Data Processing Center Department Store	*1/2 as loud
Light Traffic (100 ft)	50	Private Business Office	*1/4 as loud
Bird Calls (distant)	40	Lower Limit of Urban Ambient Sound	**Quiet** *1/8 as loud
Soft Whisper (5 ft)	30	Quiet Bedroom	**Very Quiet**
	20	Recording Studio	
	10	–	**Extremely Quiet**
	0	–	**Threshold of Hearing**

Source: Compiled by URS Corporation from various published sources and widely-used references such as The Handbook of Acoustical Measurements and Noise Control, Third Edition, edited by C.M. Harris, 1991; Federal Agency Review of Selected Airport Noise Analysis Issues, 1992, Modified by The Louis Berger Group, Inc., 2004 and Noise and Vibration Control, Second Edition, edited by L.L. Beranek, 1988 Institute of Noise Control Engineering.

1.5 Applicable Noise Criteria

Federal and state governments do not provide any specific guidelines for construction noise other than OSHA guidelines for worker protection. The proposed project is located in the vicinity of four convergent jurisdictions: the City of Folsom, Sacramento County, Placer County, and El Dorado County. Construction noise from the project may impact noise sensitive receptors in each of these four jurisdictions. These noise sensitive receptors consist of both human receptors and wildlife receptors. The applicable noise ordinances for each of the four jurisdictions are discussed and summarized in this section.

Each jurisdiction has its own unique standards regarding noise and nuisance. These standards are set out in county or municipal codes and general plans. Each noise ordinance and/or noise element within a municipal/county code or general plan will address noise levels that create a nuisance on surrounding communities. Noise ordinances occasionally classify different districts within these communities based on zoning standards. Such zones can include residential areas (analyzed further based on the density of the population), industrial areas, commercial areas, agricultural areas and rural areas, among many more. The possible adverse effects of construction noise are included in municipal noise ordinances.

Noise sound levels, the ambient noise, the distance to the noise source, the time of day, the length of the noise and the zoning of the areas in question are all considered when considering the adverse effects of noise. All municipal codes categorize noise by decibel levels that are A-weighted (dBA). Most standards use a baseline originating from an L_{50}, which states that the 50^{th} percentile of measured one-second noise levels throughout a given timeframe cannot be exceeded. This 50^{th} percentile means that half of the measured one-second noise levels within the given timeframe will fall below this number and half of the measured one-second noise levels will be above this number. Therefore, if a noise source is generating noise levels over a given timeframe, the 50^{th} percentile of the one-second noise levels that are being generated cannot exceed the L_{50} metric found in the noise standard. Some standards will use an hourly continuous noise equivalent level (L_{eq}) in order to express the sound levels over a given timeframe, which is an hour in this case, as a measurement that would equal the same energy of the fluctuating sound level over the entire time that a measurement was taken. An hourly L_{eq} will be a higher level than an L_{50} because it is taking the top 50^{th} percentile into account while the L_{50} does not.

Noise generated by off-site traffic is related to construction and there are no applicable noise assessment criteria because this type of traffic is temporary in nature and has no operational noise impacts.

1.5.1 City of Folsom

The City of Folsom uses L_{50} as the baseline criterion level. Construction noise is exempt from these regulations during the periods of 7:00 a.m. to 6:00 p.m. on weekdays and 8:00 a.m. to 5:00 p.m. on weekends. If construction were to occur outside of these periods, activities would be required to comply with exterior and interior noise limits at residential receptors, as summarized in Table 2. In the event the measured ambient noise level exceeds the applicable noise level standard in Table 2, the applicable standard shall be adjusted so as to equal the ambient noise level. For impulse noise (such as impact pile driving or blasting), the limits are reduced by 5 dBA.

Table 2: Noise Ordinance Standards (City of Folsom)*

	Noise Levels Not To

			Be Exceeded In Residential Zone (dBA)**	
Exterior Noise Standards	**Maximum Time of Exposure**	**Noise Metric**	**7 a.m. to 10 p.m. (daytime)**	**10 p.m. to 7 a.m. (nighttime)**
	30 Minutes/Hour	L_{50}	50	45
	15 Minutes/Hour	L_{25}	55	50
	5 Minutes/Hour	$L_{8.3}$	60	55
	1 Minute/Hour	$L_{1.7}$	65	60
	Any period of time	L_{max}	70	65
Interior Noise Standards				
	5 Minutes/Hour	$L_{8.3}$	45	35
	1 Minute/Hour	$L_{1.7}$	50	40
	Any period of time	L_{max}	55	45

*Construction Noise Exemption Times: 7:00 a.m. - 6:00 p.m. Weekdays
8:00 a.m. - 5:00 p.m. Weekends
**5 dBA reduction for impact noise during non-exempt times
SOURCE: City of Folsom, CA Municipal Code. Chapter 8.42, Table 8.42.040

1.5.2 Sacramento County

Like the City of Folsom, the Sacramento County Noise Ordinance specifies noise levels in terms of L_{50}. Construction noise levels are exempt from 6:00 a.m. to 8:00 p.m. on weekdays and 7:00 a.m. to 8:00 p.m. on weekends. If construction were to occur outside of these periods, activities would be required to comply with exterior and interior noise limits at residential receptors, as summarized in Table 3. For impulse noise (such as impact pile driving or blasting), the limits are reduced by 5 dBA.

Table 3: Noise Ordinance Standards (Sacramento County)*

			Noise Levels Not To Be Exceeded In Residential Zone (dBA)**	
Exterior Noise Standards	**Maximum Time of Exposure**	**Noise Metric**	**7 a.m. to 10 p.m. (daytime)**	**10 p.m. to 7 a.m. (nighttime)**
	30 Minutes/Hour	L_{50}	55	50
	15 Minutes/Hour	L_{25}	60	55
	5 Minutes/Hour	$L_{8.3}$	65	60
	1 Minute/Hour	$L_{1.7}$	70	65

	Any period of time	L_{max}	75	70
Interior Noise Standards				
	5 Minutes/Hour	$L_{8.3}$	-	-
	1 Minute/Hour	$L_{1.7}$	-	-
	Any period of time	L_{max}	-	-

*Construction Noise Exemption Times: 6:00 a.m. - 8:00 p.m. Weekdays
7:00 a.m. - 8:00 p.m. Weekends
**5 dBA reduction for impact noise during non-exempt times
SOURCE: Sacramento County Municipal Code, Chapter 6.68.070.

1.5.3 Placer County

Placer County, unlike Sacramento County and the City of Folsom, prescribes an hourly L_{eq} instead of an L_{50} standard and specifies that noise levels should be measured at the property line. Similar to Sacramento County and Folsom, construction noise is exempt from 6:00 a.m. to 8:00 p.m. on weekdays and 8:00 a.m. to 8:00 p.m. on weekends. If construction were to occur outside of these periods, activities would be required to comply with exterior and interior noise limits at residential receptors, as summarized in Table 4. For impulse noise (such as impact pile driving or blasting), the limits are reduced by 5 dBA. A variance may be applied for if noise levels are expected to exceed these limits.

Table 4: Noise Ordinance Standards (Placer County)*

Sound Level Descriptor	**Noise Levels Not To Be Exceeded in Residential Zone (dBA)****	
	7 a.m. to 10 p.m. (daytime)	**10 p.m. to 7 a.m. (nighttime)**
Hourly L_{eq}	55	45
Any Period of Time (L_{max})	70	65

*Construction Noise Exemption Times: 6:00 a.m. – 8:00 p.m. Weekdays
8:00 a.m. – 8:00 p.m. Weekends
**5 dBA reduction for impact noise during non-exempt times
SOURCE: Placer County Code, Chapter 9.36.

1.5.4 El Dorado County

The County of El Dorado Noise Element is contained within Chapter 6.5 of the El Dorado County General Plan. El Dorado County uses hourly L_{eq} in order to categorize noise disturbance, but further regulates noise according to land use zone, and applies different noise standards to each zone. construction noise exempt times include 7:00 a.m. to 7:00 p.m. on weekdays and 8:00 a.m. to 5:00 p.m. on weekends and holidays. If construction were to occur outside of these periods, activities would be required to comply with exterior noise limits at residential receptors, as summarized in Table 5. For impulse noise (such as impact pile driving or blasting), the limits are reduced by 5 dBA. A variance may be applied for of noise levels are expected to exceed these limits, and would require noise monitoring. El Dorado County adds an hourly evening L_{eq} between 7:00 p.m. to 10:00 p.m. As shown in Table 5, the evening L_{eq} takes the last 3 hours from a daytime L_{eq} and applies a different criterion to it. In addition to adding an evening standard, community and rural districts are split and given distinct criteria. A 5 dBA reduction in all noise level limits will be applied for impulse noise.

Tables 6, 7 and 8 categorize separate zones and the construction noise standards that apply to each of the regions and the planned land use in each region. Table 6 refers to areas that are community regions or adopted plan areas. Table 7 refers to areas that are designated as rural centers. Table 8 refers to areas that are rural regions. According to Policy 6.5.1.12 of the El Dorado County General Plan, at outdoor activity areas of residential use, if the existing or projected future traffic levels are less than 60 dBA L_{dn} and there is going to be more than a 5 dBA L_{dn} increase in level from new traffic, this is considered significant. If the levels are or will be between 60 and 65 dBA L_{dn}, a 3 dBA L_{dn} increase or more is considered significant, and, finally, if the levels are or will be greater than 65 dBA L_{dn}, an increase of 1.5 dBA L_{dn} or more is considered significant. Increases in the L_{dn} that are greater than this will pose a problem and construction will need to be reassessed. Ambient noise level increases of more than 5 dBA will be deemed a nuisance if the ambient noise level is in accordance to Table 5. If the ambient noise level is not in accordance with Table 6, then only a 3 dBA increase is allowed.

Table 5. Noise Level Performance Protection Standards For Noise Sensitive Land Uses Affected by Non-Transportation Sources (El Dorado County)*

Noise Level Descriptor	Noise Levels Not To Be Exceeded in Residential Zones (dBA)**					
	7 a.m. - 7 p.m. (daytime)		7 p.m. - 10 p.m. (evening)		10 p.m. - 7 a.m. (nighttime)	
	Commu-nity	Rural	Commu-nity	Rural	Commu-nity	Rural
Hourly L_{eq}	55	50	50	45	45	40
Any Period of Time (L_{max})	70	60	60	55	55	50

*Construction Noise Exemption Times: 7:00 a.m. – 7:00 p.m. Weekdays
8:00 a.m. – 5:00 p.m. Weekends/Holidays

**5 dBA reduction for impact noise during non-exempt times

SOURCE: El Dorado County General Plan, Chapter 6.5.

Table 6. Maximum Allowable Noise Exposure For Non-Transportation Noise Sources In Community Regions and Adopted Plan Areas - Construction Noise (El Dorado County)

Land Use Designation	Time Period	Noise Level (dBA)**	
		L_{eq}	L_{max}
Higher-Density Residential	7 a.m. - 7 p.m.	55	75
	7 p.m. - 10 p.m.	50	65
	10 p.m. - 7 a.m.	45	60
Commercial and Public Facilities	7 a.m. - 7 p.m.	70	90
	7 p.m. - 7 a.m.	65	75
Industrial	Any Time	80	90

Table 7. Maximum Allowable Noise Exposure For Non-Transportation Noise Sources In Rural Centers - Construction Noise (El Dorado County)*

Land Use Designation	Time Period	Noise Level (dBA)**	
		L_{eq}	L_{max}
All Residential	7 a.m. - 7 p.m.	55	75
	7 p.m. - 10 p.m.	50	65
	10 p.m. - 7 a.m.	40	55
Commercial, Recreation, and Public Facilities	7 a.m. - 7 p.m.	65	75
	7 p.m. - 7 a.m.	60	70
Industrial	Any Time	70	80
Open Space	7 a.m. - 7 p.m.	55	75
	7 p.m. - 7 a.m.	50	65

Table 8. Maximum Allowable Noise Exposure For Non-Transportation Noise Sources In Rural Regions - Construction Noise (El Dorado County)*

Land Use Designation	Time Period	Noise Level (dBA)**	
		L_{eq}	L_{max}
All Residential	7 a.m. - 7 p.m.	55	75
	7 p.m. - 10 p.m.	50	6
	10 p.m. - 7 a.m.	40	55
Commercial, Recreation, and Public	7 a.m. - 7 p.m.	65	75

Facilities	7 p.m. - 7 a.m.	60	70
Rural Land, Natural Resources, Open Space and Agricultural Land	7 a.m. - 7 p.m.	70	80
	7 p.m. - 7 a.m.	55	75

1.5.5 Wildlife Noise Criteria

Potential noise-sensitive biological receptors were identified by project biologists within a five-mile radius of the project site. Eight potential sites were identified: all are nesting or rookery habitat for four bird species. These include the tri-colored blackbird (*Agelaius tricolor*), great egret (*Casmerodius albus*), great blue heron (*Ardea herodias*), and white-tailed kite (*Elanus leucurus*).

Noise criteria for these species have not been designated. The Draft Comprehensive Species Management Plan for the least Bell's vireo evaluated the potential for masking of least Bell's vireo (*Vireo bellii pusillus*) song by traffic noise and recommended that continuous noise levels above 60 dBA L_{eq} within habitat areas may affect the suitability of habitat use by least Bell's vireo (SANDAG 1988). Since then, many regulatory agencies recommend the use of 60 dBA L_{eq} hourly levels to be considered a significant impact for sensitive bird species at the edge of suitable habitat.

In the absence of species specific criteria, the 60 dBA L_{eq} will be used to determine noise impacts on wildlife.

The National Oceanic and Atmospheric Administration (NOAA) Fisheries and U.S. Fish and Wildlife Service (USFWS) have agreed upon the use of interim criteria for injury to fish from pile driving or blasting. The current thresholds for injury are 206 dB peak, 187 dB cumulative SEL for fish greater than 2 grams, and 183 dB cumulative SEL for fish less than 2 grams. The current threshold for disturbance is 150 dB RMS.

1.5.6 Assessment Criteria

In order to determine the noise effects of the project, the closest jurisdiction with the most restrictive noise level guidelines will be used as the construction noise level criterion threshold for most project-related activities on human sensitive receptors. For the purpose of this project, the City of Folsom's noise standards will be followed because it is the closest jurisdiction with the most restrictive noise ordinance. Project compliance with City of Folsom standards will guarantee project compliance with all relevant ordinances.

Where construction activities would be conducted outside of the City of Folsom construction noise exempt times, then the exterior noise standards limits are used to determine level of effect. In the event the measured ambient noise level exceeds the applicable noise level standard in Table 2, the applicable standard shall be adjusted so as to equal the ambient noise level. If the ambient noise level is above 50 dBA, then this becomes the new standard at each individual noise-sensitive receptor.

The 60 dBA L_{eq} will be used to determine noise impacts on birds and the noise impacts on fish will be addressed qualitatively.

1.6 Existing Noise Environment

The proposed project would be located in City of Folsom on the south side of Folsom Lake. The proposed project area would be located southeast of the Folsom Dam, east of American River and northwest of Folsom Point. There are four proposed staging areas:

- the MIAD disposal area
- the Dike 7 staging area northeast of the intersection of Folsom Lake Crossing and East Natoma Street
- the Overlook Staging Area located directly west of the proposed spur dike
- The Prison Staging Area located southeast of Folsom Lake Crossing and north of Folsom Prison Road and just east of the American River.

Folsom State Prison is located south of the proposed project area. The haul road, which would be used to transport material from the approach channel to disposal areas, runs east from the proposed project area along the edge of Folsom Lake to the MIAD disposal site. The haul road comes within less than 1,000 feet of houses located along Mountain View Drive and Elvie Lane and runs just south of Folsom Point. Several residential areas within the project vicinity may be affected by noise from approach channel excavation, spur dike construction, transload facility construction and removal, staging area operations, blasting and traffic.

1.6.1 Noise-Sensitive Receptors

Noise-sensitive receptors are defined as areas where there is a reasonable degree of sensitivity to noise. These areas include human dwellings, hospitals, schools, churches or libraries. Wildlife may also be sensitive to noise, and certain types of habitat, such as nesting areas for migratory or special status birds, may be considered noise-sensitive receptors.

There are several areas within the City of Folsom that are classified as noise-sensitive receptors. These include:

- Folsom State Prison. The prison is located approximately 2,700 feet south of proposed approach channel excavation activities, 2,300 feet west of the proposed Dike 7 staging area, and is considered a residential area.
- A residential neighborhood located approximately 5,700 feet west of proposed approach channel excavation activities and the Overlook staging area. The residential community is an apartment complex located west of American River and east of the Folsom Auburn Road and Pierpoint Circle intersection.
- A large neighborhood that stretches from the western intersection of Briggs Ranch Drive and East Natoma Street to the intersection of Green Valley Road and East Natoma Street. Residences in this neighborhood are located approximately 3,700 feet south of proposed approach channel excavation activities, 1,000 feet south of the Dike 7 staging area, and approximately 600 feet south of the MIAD disposal and staging areas.

- Several residences scattered throughout the area located immediately west of Folsom Point and Folsom Lake Crossing. These single-family residences are located within 500 feet of the haul road and 400 feet of the Dike 7 Staging Area. The closest residences to the proposed approach channel excavation activities are located at the western end of Mountain View Drive and the western end of Lorena Lane. These residences are located approximately 3,300 feet southeast of proposed approach channel excavation activities.
- Recreationists using Folsom Point. The park is located approximately 4,800 feet southeast of proposed approach channel excavation activities and within 500 feet of the proposed Dike 7 staging area and MIAD disposal area. Folsom Point is a day-use facility that closes at sunset.
- A residential community located approximately 8,000 feet southeast of proposed approach channel excavation activities and across the street from the MIAD disposal and staging areas. This community is located at the northeast corner of Green Valley Road and East Natoma Street.
- Two residences located directly southwest of the boundary of the proposed MIAD staging area. These homes are located at the northeast corner of Briggs Ranch Drive and East Natoma Street. The nearest residence is located approximately 300 feet southwest of the MIAD staging area.

Within Placer County, the Beals Point campground is located about 8,600 feet northwest of proposed approach channel excavation activities. This park is located east of where State Rec Area Road and Beals Point intersect.

The only sensitive receptors in El Dorado County that could be affected by construction noise are located in a community along Agora Way, Shadowfax Lane and Shadowfax Court. This community is approximately 2,500 feet east from the MIAD disposal area and 10,500 feet from proposed approach channel excavation activities.

Wildlife Receptors. As discussed in section 1.5.5, eight potential sensitive sites for wildlife were identified within five miles of proposed approach channel excavation activities; all are protected habitat for nesting birds. Habitats for the tri-colored blackbird are found at three locations, that are over 2 miles from proposed approach channel excavation activities to the south, southeast, and northwest, respectively. The great egret habitat is located over 4 miles southwest of proposed approach channel excavation activities. Habitat for the great blue heron is found approximately 5,000 feet west of proposed approach channel excavation activities and approximately 1,500 feet west of the proposed Prison Staging Area. This is the closest sensitive bio-receptor. White-tailed kite habitats are located over 1.8 miles to the southwest and southeast from proposed approach channel excavation activities.

1.6.2 Construction Noise Levels

Construction noise levels have the ability to affect surrounding communities and residences if proper mitigation procedures are not taken. Table 9 displays the equipment levels found in the Roadway Construction Noise Model's (RCNM) User Guide (FHWA RCNM, Version 1.0 User's Guide). The noise sources descend from highest sound level, which is an impact pile driver, to a refrigerator unit. The column on the right shows the distance at which the piece of equipment will fall to the criterion level. The “Actual Measured L_{max} at 50 feet” is used to calculate this distance unless it reads “N/A”. If the table reads “N/A”, then the specifications (Spec. 721.560) taken from the “Big Dig” in Boston are used. The “Big Dig” was a large Central Artery/Tunnel Project that utilized many types of construction equipment. During the construction of the project, noise measurements were conducted to see how much noise many of the project components were generating.

Table 9. RCNM Default Noise Emission Reference Levels and Usage Factors

Equipment Description	Acoustical Usage Factor	Spec. 721.560 Lmax @ 50ft (dBA, slow)	Actual Measured Lmax @ 50ft (dBA, slow) samples avg.	Number of Actual Data Samples (Count)	Distance At Which Level = 50 dBA (45 dBA impact) (in feet)	Distance At Which Level = 45 dBA (40 dBA impact) (in feet)
Impact Pile Driver**	20	95	101	11	31,548	56,101
Vibratory Pile Driver	20	95	101	44	17,741	31,548
Sand Blasting (single nozzle)	20	85	96	9	9,976	17,741
Sheers (on backhoe)	40	85	96	5	9,976	17,741
Hydra Break Ram**	10	90	N/A	0	8,891	15,811
Mounted Impact Hammer (hoe ram)**	20	90	90	212	8,891	15,811
Jackhammer**	20	85	89	133	7,924	14,092
Clam Shovel (dropping)**	20	93	87	4	6,295	11,194
Blasting**	50	85	N/A	0	5,000	8,891
Concrete Saw	20	90	90	55	5,000	8,891
Pavement Scarifier	20	85	90	2	5,000	8,891
Vibrating Hopper	50	85	87	1	3,540	6,295
All Other Equipment > 5 HP	50	85	N/A	0	2,812	5,000
Compressor (air)	50	85	N/A	0	2,812	5,000
Generator(<25KVA, VMS Signs)	50	85	N/A	0	2,812	5,000
Grader	40	85	N/A	0	2,812	5,000
Horizontal Boring Hydraulic Jack	50	85	N/A	0	2,812	5,000
Pneumatic Tools	50	85	85	90	2,812	5,000

Table 9. RCNM Default Noise Emission Reference Levels and Usage Factors

Equipment Description	Acoustical Usage Factor	Spec. 721.560 Lmax @ 50ft (dBA, slow)	Actual Measured Lmax @ 50ft (dBA, slow) samples avg.	Number of Actual Data Samples (Count)	Distance At Which Level = 50 dBA (45 dBA impact) (in feet)	Distance At Which Level = 45 dBA (40 dBA impact) (in feet)
Vacuum Excavator (Vac-Truck)	40	85	85	149	2,812	5,000
Auger Drill Rig	20	85	84	36	2,506	4,456
Chain Saw	20	85	84	46	2,506	4,456
Flat Bed Truck	40	84	N/A	0	2,506	4,456
Rivet Buster/Chipping Gun**	20	85	79	19	2,506	4,456
Scraper	40	85	84	12	2,506	4,456
Tractor	40	84	N/A	0	2,506	4,456
Boring Jack Power Unit	50	80	83	1	2,233	3,972
Concrete Batch Plant	15	83	N/A	0	2,233	3,972
Gradall	40	85	83	70	2,233	3,972
Warning Horn	5	85	83	12	2,233	3,972
Dozer	40	85	82	55	1,991	3,540
Grapple (on backhoe)	25	80	82	6	1,991	3,540
Vacuum Street Sweeper	10	80	82	19	1,991	3,540
Concrete Pump Truck	20	82	81	30	1,774	3,155
Crane	16	85	81	405	1,774	3,155
Excavator	40	85	81	170	1,774	3,155
Generator	50	82	81	19	1,774	3,155
Pumps	50	77	81	17	1,774	3,155
Rock Drill	20	85	81	3	1,774	3,155
Bar Bender	20	80	N/A	0	1,581	2,812
Drum Mixer	50	80	80	1	1,581	2,812
Roller	20	85	80	16	1,581	2,812
Slurry Trenching Machine	50	82	80	75	1,581	2,812
Soil Mix Drill Rig	50	80	N/A	0	1,581	2,812

Table 9. RCNM Default Noise Emission Reference Levels and Usage Factors

Equipment Description	Acoustical Usage Factor	Spec. 721.560 Lmax @ 50ft (dBA, slow)	Actual Measured Lmax @ 50ft (dBA, slow) samples avg.	Number of Actual Data Samples (Count)	Distance At Which Level = 50 dBA (45 dBA impact) (in feet)	Distance At Which Level = 45 dBA (40 dBA impact) (in feet)
Vibratory Concrete Mixer	20	80	80	1	1,581	2,812
Concrete Mixer Truck	40	85	79	40	1,409	2,506
Drill Rig Truck	20	84	79	22	1,409	2,506
Front End Loader	40	80	79	96	1,409	2,506
Ventilation Fan	100	85	79	13	1,409	2,506
Backhoe	40	80	78	372	1,256	2,233
Compactor (ground)	40	80	78	18	1,256	2,233
Slurry Plant	100	78	78	1	1,256	2,233
Paver	50	85	77	9	1,119	1,991
Dump Truck	40	84	76	31	998	1,774
Man Lift	20	85	75	23	889	1,581
Pickup Truck	40	55	75	1	889	1,581
Welder/Torch	40	73	74	5	792	1,409
Refrigerator Unit	100	82	73	3	706	1,256

1.6.3 Ambient Noise Survey

An ambient noise level survey was conducted between March 24 and March 26, 2009 in the project area to characterize existing noise conditions. The survey consisted of short-term (l0 minutes) and long-term measurements (24-hours) at noise-sensitive receptors and wildlife habitats. Weather conditions were consistent over the three days of noise monitoring. The temperature ranged from 55 degrees Fahrenheit at night to 75 degrees Fahrenheit during the day. Winds were mild to 6 or 7 miles per hour during noise monitoring. Long-term measurements were conducted using three Larson Davis Model 820 ANSI (American National Standards Institute) Type 1 Integrating Sound Level Meters (Serial Numbers 1527, 1528 and 1598). The sound level meters were bolted to trees, telephone poles or fences approximately five feet above the ground in order to approximate the height of the human ear. Short-term monitoring was conducted using a Bruel and Kjaer Model 2250 ANSI Type 1 Integrating Sound Level Meter (Serial Number 2672071). All sound level meters were calibrated before and after the measurement periods with a Larson Davis Model CAL200 calibrator (Serial Number

2794). All sound level measurements conducted by URS were in accordance with ISO 1996a, b, c.

The long-term and short-term measurement sites for human noise-sensitive receptors are summarized in Table 10 and Table 11, respectively. All long-term and short-term measurement sites are representative of single-family homes or communities near the project site. Table 12 shows measurement sites for wildlife receptors. These modeling locations were necessary for noise modeling purposes due to the residences being near proposed construction activities.

Table 10. Long-Term Measurement Sites

Site ID	Location
LT-2	Tacana Drive and East Natoma Street
LT-3	Mountain View Drive
LT-4	East Natoma Street and Green Valley Road
LT-5	Shadowfax Court
LT-6	East of Folsom Auburn Road and Pierpoint Circle

Table 11. Short-Term Measurement Sites

Site ID	Location
ST-2	Tacana Drive and East Natoma Street
ST-3	Mountain View Drive
ST-4	East Natoma Street and Green Valley Road
ST-5	Shadowfax Court
ST-6	East of Folsom Auburn Road and Pierpoint Circle
ST-7	Beals Point
ST-8	Folsom Point

Table 12. Noise Sensitive Wildlife Receptor Sites

Site ID	Location	Relevant Specie
Bio-1	Main Avenue and Sunset Avenue	Great Egret
Bio-2	5,000 Feet West of Proposed Excavation Site (near American River)	Great Blue Heron
Bio-3	Erwin Avenue and Snipes Boulevard (Snipes-Pershing Park)	White-Tailed Kite
Bio-4	South Lexington Drive and Oak Avenue Parkway	Tri-Colored Blackbird
Bio-5	Willow Bend Road and Grey Fox Court	White-Tailed Kite
Bio-6	Haddington Drive and East Natoma Street	Tri-Colored Blackbird
Bio-7	Sturbridge Drive and Stonemill Drive	White-Tailed Kite
Bio-8	Wellington Way and Grizzly Way	Tri-Colored Blackbird

1.6.4 Long-Term Site Monitoring

Five long-term measurements were conducted. Long-term data was not collected at the Folsom State Prison (LT-1) as prison security did not allow access to Prison property. In place of monitoring data for LT-1, construction noise levels were modeled at the prison on both the north and east sides of the prison in order to account for noise levels due to construction. Table 13 summarizes the long-term measurement site data for all other LT sites. The raw data for each long-term measurement site is provided in Appendix A-Noise.

Table 13. Long-Term Measurement Site Data

Site ID	Location	Start Date	Start Time	Hourly L_{eq} Range (dBA)	CNEL (dBA)
LT-2	Tacana Drive and E. Natoma St.	3/25/2009	17:00:00	51.5 - 69.4	71
LT-3	Mountain View Dr.	3/25/2009	15:00:00	32.8 - 50.9	50
LT-4	E. Natoma St. and Green Valley Rd.	3/24/2009	14:00:00	58.0 - 75.2	76
LT-5	Shadowfax Court	3/24/2009	13:00:00	34.1 - 57.5	51
LT-6	East of Folsom Auburn Rd. and Pierpoint Circle	3/24/2009	15:00:00	31.7 - 56.8	50

Hourly L_{eq}s ranged from 31.7 to 75.2 dBA and from 50 to 76 dBA CNEL depending on the location of the long-term measurement location.

1.6.5 Short-Term Site Monitoring

Eight short-term measurements were conducted during the day, evening and night for all of the corresponding long-term measurement sites except for LT-1, or Folsom State Prison, where no measurements were completed for security reasons. Each measurement lasted a total of 10 minutes. Short-term measurement Site 7 (ST-7) is located at Beals Point Campground. Beals Point Campground is located 8,600 feet northwest of the proposed Project area. Only daytime measurements could be completed here due to campground times. The campground is located on the west side of Lake Folsom. ST-8 is the measurement site located at Folsom Point. The haul road runs just south of Folsom Point. The proposed Dike 7 staging and MIAD disposal areas are located west and south of Folsom Point, respectively. The park is located approximately 4,800 feet southeast of proposed approach channel excavation activities. Daytime and evening measurements could only be completed due to the park being closed after 10:00 p.m. The data for all short-term measurements can be found in Appendix B.

1.6.6 Sensitive Wildlife Receptor Monitoring

Short-term day, evening, and night ambient noise level measurements were completed at eight noise-sensitive wildlife locations. Table 12 identifies the species as well as the location of each wildlife receptor site. The data for these locations can be found in Appendix C.

2.0 IMPACTS

2.1 Noise Prediction Model

Noise impacts for the proposed project are predicted using CadnaA for approach channel excavation, spur dike construction, transload facility construction and removal, and staging area activities. BNoise2 is used to model noise impacts from blasting. CadnaA is a Windows-based computer software modeling program that allows for the input of sound sources and their corresponding noise source output levels. CadnaA takes both topography and attenuation due to sound wave divergence into account in order to produce accurate results. BNoise2 is a computer software program that allows for the user to model blast noise sound levels over a specified range. BNoise2 generates results by taking both the type and amount of charge used when blasting is taking place.

Noise impacts due to proposed construction activities from Alternatives 2 and 3 are analyzed separately. The Microsoft Excel spreadsheet titled “Equipment Estimate Summary” provided by the USACE, dated October 24, 2011, is used in order to estimate the worst-case noise impact scenarios at human and wildlife noise-sensitive receivers during the year in which the noisiest construction activities would presumably occur for both Alternatives 2 and 3. A condensed version of the Equipment Estimate Summary for both Alternatives 2 and 3 can be found in Appendix D. Due to the vast amount of construction equipment and an indefinite construction phasing schedule listed on the Equipment Estimate Summary spreadsheet, if any individual construction activity that is listed to occur at all during any particular year, it is assumed that that particular construction activity could possibly occur at the same time as all other construction activities that may be conducted during that year. This helps provide the annual worst-case noise impact scenario that would occur sometime in between the years 2013 and 2017. Most construction activity is proposed to occur during construction noise exempt times, but since some individual construction activities may occur during nighttime hours, those nighttime activities are analyzed separately for both Alternatives 2 and 3. The noisiest activities for Alternative 2 would occur in 2017 and the noisiest construction activities for Alternative 3 would occur in 2013. The noisiest nighttime construction activities would occur in 2016 for both Alternatives 2 and 3.

Several assumptions are made regarding construction activities, not including blasting, and they include:

- Normal staging area construction operations include 2 dozers, 2 dump trucks and a batch plant at all four proposed staging areas for both Alternatives 2 and 3
- For both Alternatives 2 and 3, rock crushing activities would occur at either the MIAD staging area or at the overlook staging area and would not occur during non-exempt construction noise activities
- Potential non-exempt construction activities for both Alternatives 2 and 3 include the use of the batch plant; use of four 1500 cfm air compressors during “set up and operation of the bubble curtain and/or silt curtain”

construction activities; “dredging activities common to rock”; and “drill and shoot and dredging in-the-wet” activities

- Additional non-exempt construction activities for Alternative 3 only include ”common dredging below cofferdam” activities; and “dewatering behind cofferdam” activities
- For Alternative 2, the worst case annual noise construction level year is 2017, and there would be approximately 13,167 annual truck round-trips along the on-site haul road going to and from the MIAD and Dike 7 areas and spur dike construction area
- For Alternative 3, the worst case annual noise construction level year is 2013, and there would be approximately 8,960 annual truck round-trips along the on-site haul road going to and from the MIAD and the approach channel excavation area; 900 annual truck round-trips going to and from the transload facility and MIAD and Dike 7 areas, and 3,740 annual truck round-trips to move cofferdam cell fill material that would be assumed to be coming from the MIAD. The total annual truck round-trips along the on-site haul road in 2013 is 13,600
- Using the total number of annual truck round-trips along the on-site haul road for both Alternatives 2 and 3, there would be approximately 4.5 truck round-trips per day that will be used for modeling purposes

2.1.1 Construction Schedules and Durations for Alternatives 2 and 3

Construction of both Alternatives 2 and 3 would begin in mid-2013 and end in late 2017. Tables 14 and 15 provide a schedule for all construction activities listed in the Equipment Estimate Summary for Alternatives 2 and 3, respectively. The tables list construction activities and the years in which they may occur. Additional construction activities listed in the table, but not listed on the original provided Equipment Estimate Summary, include all four staging area construction activities; and on-site haul road usage going to and from the MIAD and Project site during approach channel excavation and spur dike construction; and on-site haul road usage going to and from the MIAD and transload facility during construction of the transload facility. There would only be one batch plant located at one of the four proposed staging areas. Batch plant operations have the potential to be conducted during non-exempt construction noise hours. All potential non-exempt construction noise activities are marked with an “asterisk”. Rock crushing activities would be conducted at either the MIAD staging area or Overlook staging area. In Tables 14 and 15, for each year, every construction activity is marked if it would occur at some time during that year.

For both Alternatives 2 and 3, blasting would take place in between February 2014 and August 2017. Blasting activities are not listed in Tables 14 and 15 because blast noise impacts are analyzed separately.

Table 14. Alternative 2 Proposed Construction Activities by Year

Construction Activity	2013	2014	2015	2016	2017
Site Prep / Haul Road Prep	X	X			
Construct Transload Facility	X				
Concrete Secant Pile Wall	X	X	X	X	
Cutoff Wall Concrete Placement	X	X	X	X	
Common Excavation to Waste	X				
MIAD Staging Area w/ Rock Crusher	X	X	X	X	X
MIAD Staging Area Batch Plant*	X	X	X	X	X
Dike 7 Staging Area	X	X	X	X	X
Dike 7 Staging Area Batch Plant*	X	X	X	X	X
Overlook Staging Area w/ Rock Crusher	X	X	X	X	X
Overlook Staging Area Batch Plant*	X	X	X	X	X
Prison Staging Area	X	X	X	X	X
Prison Staging Area Batch Plant*	X	X	X	X	X
On-Site Haul Road Usage to and From Excavation Site and MIAD***	X	X	X	X	X
On-Site Haul Road Usage for Construction of Transload Facility***	X				
Rock Excavation Dry		X			
Site Restoration Teardown		X			
Mobilization for Approach Walls			X		
Intake Approach Walls and Slab			X	X	X
Set up and Operate Bubble Curtain / Silt Curtain**			X		
Dredge Common to Rock*			X	X	
Drill and Shoot / Dredge Rock Wet*				X	X
Haul Road Prep and Spur Dike Stripping				X	
Import Material from Quarry to D1/D2 MIAD				X	X
Rehandle All Imported Material to Spur Dike from D1/D2 MIAD, Emb Core and Rock Fill					X
Rehandle All Imported Material to Spur Dike from D1/D2 MIAD, Rip Rap Bedding and Rip Rap					X

Table 14. Alternative 2 Proposed Construction Activities by Year

Construction Activity	2013	2014	2015	2016	2017
Foundation Clean Up					X
Remove Transload Facility					X

*potential nighttime construction activity
**potential nighttime construction activity (four 1500 CFM compressors only)
***total SPL at a distance of 50 feet is 52.6 dBA L_{eq} from 4.5 haul truck round-trips along haul road

Table 15. Alternative 3 Proposed Construction Activities by Year

Construction Activity	2013	2014	2015	2016	2017
Mobilization for Cofferdam	X	X			
Construct Transload Facility	X				
Common Excavation Below Cofferdam	X				
Common Dredge Below Cofferdam*	X				
Construction of Sheet Pile Cells	X	X			
Fill Cells	X	X			
Set up and Operate Bubble Curtain / Silt Curtain**	X				
MIAD Staging Area w/ Rock Crusher	X	X	X	X	X
MIAD Staging Area Batch Plant*	X	X	X	X	X
Dike 7 Staging Area	X	X	X	X	X
Dike 7 Staging Area Batch Plant*	X	X	X	X	X
Overlook Staging Area w/ Rock Crusher	X	X	X	X	X
Overlook Staging Area Batch Plant*	X	X	X	X	X
Prison Staging Area	X	X	X	X	X
Prison Staging Area Batch Plant*	X	X	X	X	X
On-Site Haul Road Usage to and From Excavation Site and MIAD	X	X	X	X	X
On-Site Haul Road Usage for Construction of Transload Facility	X				
Dewater Behind Cofferdam*		X			
Site Restoration / Teardown		X			
Mobilization for Approach Walls			X		
Intake Approach Walls and Slab			X	X	X
Common Excavation to Waste			X	X	X
Rock Excavation Dry			X	X	X
Haul Road Prep and Spur Dike Stripping				X	

Table 15. Alternative 3 Proposed Construction Activities by Year

Construction Activity	2013	2014	2015	2016	2017
Import Material from Quarry to D1/D2 MIAD				X	X
Remove Cell Rubble Fill					X
Remove Sheets					X
Dredge Common to Rock*					X
Drill and Shoot / Dredge Rock Wet*					X
Rehandle All Imported Material to Spur Dike from D1/D2 MIAD, Emb Core and Rock Fill					X
Rehandle All Imported Material to Spur Dike from D1/D2 MIAD, Rip Rap Bedding and Rip Rap					X
Foundation Clean Up					X
Remove Transload Facility					X

*potential nighttime construction activity
**potential nighttime construction activity (four 1500 CFM compressors only)

2.1.2 Areas of Construction Activity and Associated Noise Source Levels for Alternatives 2 and 3

Tables 14 and 15 list all of the construction activities that can be found on the Equipment Estimate Summary provided by the USACE for Alternatives 2 and 3. Appendix D provides a detailed breakdown of the equipment required for each activity. In Appendix D, under each construction activity, the quantity; horsepower; hours per day; duty cycle; total sound pressure levels (SPL) at 50 feet and sound power levels (PWL) for the quantity of individual types of equipment; and total SPLs at 50 feet and PWLs for all of the equipment combined for each construction activity are listed. Tables 16 and 17, below, present areas where the individual construction activities occur, along with the total combined SPL (at 50 feet) and PWL for all of the required construction equipment. The areas of designation for the construction activities are significant because these designated areas are where each individual construction activity are modeled. On-site haul road truck usage for both approach channel excavation/spur dike construction activities and transload facility construction activities have been combined into one activity in order to generate a worst case annual haul road round-trip SPL at 50 feet for all trips.

Table 16. Alternative 2 Areas of Construction Activity and Associated Noise Source Levels

Construction Activity	Area of Construction							Total SPL @ 50 Feet per Construction Activity (dBA L_{eq})	Total PWL per Construction Activity (dBA L_{eq})
	Approach Channel / Spur Dike	Transload Facility	MIAD Staging Area	Dike 7 Staging Area	Overlook Staging Area	Prison Staging Area	Haul Road		
Site Prep / Haul Road Prep	X							93.0	127.6
Construct Transload Facility		X						91.6	126.2
Concrete Secant Pile Wall	X							89.1	123.7
Cutoff Wall Concrete Placement	X							82.1	116.7
Common Excavation to Waste	X							90.5	125.1
MIAD Staging Area w/ Rock Crusher			X					88.0	122.6
MIAD Staging Area Batch Plant*			X					83.0	117.6
Dike 7 Staging Area				X				86.4	121.0
Dike 7 Staging Area Batch Plant*				X				83.0	117.6
Overlook Staging Area w/ Rock Crusher					X			88.0	122.6
Overlook Staging Area Batch Plant*					X			83.0	117.6
Prison Staging Area						X		86.4	121.0
Prison Staging Area Batch Plant*						X		83.0	117.6
All On-Site Haul Road Usage***							X	52.6	n/a
Rock Excavation Dry	X							91.2	125.8

Table 16. Alternative 2 Areas of Construction Activity and Associated Noise Source Levels

Construction Activity	Area of Construction							Total SPL @ 50 Feet per Construction Activity (dBA L_{eq})	Total PWL per Construction Activity (dBA L_{eq})
	Approach Channel / Spur Dike	Transload Facility	MIAD Staging Area	Dike 7 Staging Area	Overlook Staging Area	Prison Staging Area	Haul Road		
Site Restoration Teardown	X							92.5	127.0
Mobilization for Approach Walls	X							89.7	124.3
Intake Approach Walls and Slab	X							84.9	119.5
Set up and Operate Bubble Curtain / Silt Curtain**	X							93.1	127.7
Dredge Common to Rock*	X							96.0	130.6
Drill and Shoot / Dredge Rock Wet*	X							96.4	131.0
Haul Road Prep and Spur Dike Stripping	X							89.3	123.9
Import Material from Quarry to D1/D2 MIAD	X							90.6	125.2
Rehandle All Imported Material to Spur Dike from D1/D2 MIAD, Emb Core and Rock Fill	X							88.7	123.3
Rehandle All Imported Material to Spur Dike from D1/D2 MIAD, Rip Rap Bedding and Rip Rap	X							84.1	118.7

Table 16. Alternative 2 Areas of Construction Activity and Associated Noise Source Levels

Construction Activity	Area of Construction							Total SPL @ 50 Feet per Construction Activity (dBA L_{eq})	Total PWL per Construction Activity (dBA L_{eq})
	Approach Channel / Spur Dike	Transload Facility	MIAD Staging Area	Dike 7 Staging Area	Overlook Staging Area	Prison Staging Area	Haul Road		
Foundation Clean Up	X							96.0	130.6
Remove Transload Facility		X						91.6	126.2

*potential nighttime activity
**potential nighttime activity (four 1500 CFM compressors only)
***total SPL @ 50 feet is 52.6 dBA Leq from 4.5 haul truck round-trips along haul road (calculated using FHWA model)

Table 17. Alternative 3 Areas of Construction Activity and Associated Noise Source Levels

Construction Activity	Area of Construction							Total SPL @ 50 Feet per Construction Activity (dBA L_{eq})	Total PWL per Construction Activity (dBA L_{eq})
	Approach Channel / Spur Dike	Transload Facility	MIAD Staging Area	Dike 7 Staging Area	Overlook Staging Area	Prison Staging Area	Haul Road		
Mobilization for Cofferdam	X							93.2	127.8
Construct Transload Facility		X						91.6	126.2
Common Excavation Below Cofferdam	X							90.4	124.9
Common Dredge Below Cofferdam*	X							96.8	131.4
Construction of Sheet Pile Cells	X							101.7	136.3
Fill Cells	X							102.2	136.8

Table 17. Alternative 3 Areas of Construction Activity and Associated Noise Source Levels

Construction Activity	Area of Construction							Total SPL @ 50 Feet per Construction Activity (dBA L_{eq})	Total PWL per Construction Activity (dBA L_{eq})
	Approach Channel / Spur Dike	Transload Facility	MIAD Staging Area	Dike 7 Staging Area	Overlook Staging Area	Prison Staging Area	Haul Road		
Set up and Operate Bubble Curtain / Silt Curtain**	X							92.8	127.4
MIAD Staging Area w/ Rock Crusher			X					88.0	122.6
MIAD Staging Area Batch Plant*			X					83.0	117.6
Dike 7 Staging Area				X				86.4	121.0
Dike 7 Staging Area Batch Plant*				X				83.0	117.6
Overlook Staging Area w/ Rock Crusher					X			88.0	122.6
Overlook Staging Area Batch Plant*					X			83.0	117.6
Prison Staging Area						X		86.4	121.0
Prison Staging Area Batch Plant*						X		83.0	117.6
All On-Site Haul Road Usage***							X	52.6	n/a
Dewater Behind Cofferdam*	X							95.9	130.4
Site Restoration / Teardown	X							92.5	127.0
Mobilization for Approach Walls	X							89.7	124.3
Intake Approach Walls and Slab	X							84.9	119.5

Table 17. Alternative 3 Areas of Construction Activity and Associated Noise Source Levels

Construction Activity	Area of Construction							Total SPL @ 50 Feet per Construction Activity (dBA L_{eq})	Total PWL per Construction Activity (dBA L_{eq})
	Approach Channel / Spur Dike	Transload Facility	MIAD Staging Area	Dike 7 Staging Area	Overlook Staging Area	Prison Staging Area	Haul Road		
Common Excavation to Waste	X							92.7	127.3
Rock Excavation Dry	X							91.1	125.7
Haul Road Prep and Spur Dike Stripping	X							89.3	123.9
Import Material from Quarry to D1/D2 MIAD	X							90.6	125.2
Remove Cell Rubble Fill	X							87.7	122.3
Remove Sheets	X							94.4	128.9
Dredge Common to Rock*	X							96.0	130.6
Drill and Shoot / Dredge Rock Wet*	X							96.3	130.9
Rehandle All Imported Material to Spur Dike from D1/D2 MIAD, Emb Core and Rock Fill	X							89.0	123.6
Rehandle All Imported Material to Spur Dike from D1/D2 MIAD, Rip Rap Bedding and Rip Rap	X							84.1	118.7

Table 17. Alternative 3 Areas of Construction Activity and Associated Noise Source Levels

Construction Activity	Area of Construction							Total SPL @ 50 Feet per Construction Activity (dBA L_{eq})	Total PWL per Construction Activity (dBA L_{eq})
	Approach Channel / Spur Dike	Transload Facility	MIAD Staging Area	Dike 7 Staging Area	Overlook Staging Area	Prison Staging Area	Haul Road		
Foundation Clean Up	X							96.0	130.6
Remove Transload Facility		X						91.2	125.8

*potential nighttime construction activity
**potential nighttime construction activity (four 1500 CFM compressors only)
***total SPL @ 50 feet is 52.6 dBA L_{eq} from 4.5 haul truck round-trips along haul road (calculated using FHWA model)

For both alternatives, the most, and noisiest, construction activities are being conducted at the approach channel excavation and spur dike construction areas. Noise generated by haul road trips is the construction activity that generates the least amount of noise because the trucks are going at a relatively low speed and they only briefly pass by noise-sensitive receptors.

2.2 Noise Prediction model Method for construction activities

Tables 14 through 17 are used to calculate total combined sound power levels for all of the construction activities that are taking place in distinct areas of the overall proposed Project area. These total combined sound power levels for distinct areas are used for the CadnaA model as a worst case year construction noise level scenario. For example, Table 14 identifies the years in which all construction activities would be conducted for Alternative 2. Table 15 identifies the specific areas where the construction activities for Alternative 2 would be conducted along with the combined total sound pressure levels (SPLs) at 50 feet and sound power levels (PWLs) for each construction activity. Referring to Table 14, there are a total of 16 total construction activities that would be conducted during 2017. By cross-referencing Tables 14 and 16, it is found that six of those construction activities would be conducted near the approach channel excavation and spur dike construction area in 2017. The PWLs found in Table 16 for those six construction activities are then summed up to generate a total PWL for the approach channel excavation and spur dike construction area. In 2017, and for Alternative 2, the acoustic power level for all construction activities being conducted at the approach channel excavation and spur dike construction area is 134.9 dBA PWL. This process is carried out for both Alternatives 2 and 3 for the following designated construction areas in order find the year with the worst-case noise generating scenario due to construction:

- Approach Channel Excavation and Spur Dike Construction Area
- Transload Facility Construction and Removal Area
- MIAD Staging Area
- Dike 7 Staging Area
- Overlook Staging Area
- Prison Staging Area
- Haul Road

Blast noise and off-site traffic noise due to construction is analyzed separately from the rest of on-site construction activities listed in Tables 14 through 17.

2.2.1 Noise Prediction Model Inputs for Construction Activities Conducted During Construction Noise Exempt Hours for Alternatives 2 and 3

Tables 18 and 19 list the combined PWLs for all of the construction equipment for activities being conducted during daytime hours at each respective construction area by year. Construction activities would be conducted from year 2013 through 2017 at the approach channel excavation and spur dike construction area. Transload facility construction occurs in 2013 and removal of the transload facility occurs in 2017. Rock crushing would only occur at either the MIAD or overlook staging area, but not at both.

Haul road round-trips cannot be assigned a PWL because traffic noise is measured by the sound pressure level (SPL) at 50 feet.

Table 18. Alternative 2 Total Combined PWL for Each Area of Construction by Year (dBA)

Area of Construction	2013	2014	2015	2016	2017
Approach Channel / Spur Dike	130.7	132.4	133.7	134.8	134.9
Transload Facility	126.2	0.0	0.0	0.0	126.2
MIAD Staging Area w/ Rock Crusher	122.6	122.6	122.6	122.6	122.6
Dike 7 Staging Area	121.0	121.0	121.0	121.0	121.0
Overlook Staging Area w/ Rock Crusher	122.6	122.6	122.6	122.6	122.6
Prison Staging Area	121.0	121.0	121.0	121.0	121.0
Haul Road*	n/a	n/a	n/a	n/a	n/a

*noise due to on-site haul road round-trips is analyzed using FHWA Model that generated SPLs

Table 19. Alternative 3 Total Combined PWL for Each Area of Construction by Year (dBA)

Area of Construction	2013	2014	2015	2016	2017
Approach Channel / Spur Dike	140.7	140.3	131.0	132.0	137.9
Transload Facility	126.2	0.0	0.0	0.0	126.2
MIAD Staging Area w/ Rock Crusher	122.6	122.6	122.6	122.6	122.6
Dike 7 Staging Area	121.0	121.0	121.0	121.0	121.0
Overlook Staging Area w/ Rock Crusher	122.6	122.6	122.6	122.6	122.6
Prison Staging Area	121.0	121.0	121.0	121.0	121.0
Haul Road*	n/a	n/a	n/a	n/a	n/a

*noise due to on-site haul road round-trips is analyzed using FHWA Model that generated SPLs

Table 18 confirms that construction activities during year 2017 would generate the highest levels of noise associated with Alternative 2, and Table 19 confirms that construction activities during year 2013 would generate the highest levels of noise associated with Alternative 3. Construction activities conducted outside of construction noise exempt hours are analyzed and modeled separately from the rest of construction activities because most of them will be limited in scope and size compared to the rest of the construction activities.

In the CadnaA model, "area sources" are input near the general vicinity of where the proposed area of construction would be conducted. The area sources are input into the CadnaA model with the overall PWL found under the year 2017 column for each respective construction activity in order to generate a worst-case scenario from noise due to construction. Using Alternative 2, for example, in the vicinity of the approach channel excavation and spur dike construction area, an area source is input into the CadnaA model that has a PWL of 134.9 dBA and an area source with a PWL of 126.2 dBA is input into the model where the transload facility would be located. The same goes for the four staging areas and their respective PWLs. Table 20 displays the general octave band spectrum for diesel engines that is used to input area sources in the CadnaA model. This octave band spectrum originates from the octave band spectrum for an articulated 40 ton truck found in the 2009 Early Approach Channel Excavation EA/IS (Corps, 2009). Each octave band level is increased in order to reflect the overall PWL for each area of construction in the CadnaA model. For example, each octave band level is increased 29.9 dBA for approach channel excavation and spur dike construction (134.9 – 105 = 29.9) using the numbers in Table 19 in order to make up for the difference in overall PWLs. Then, those respective octave band levels are input into the CadnaA model for each respective area source.

Table 20. PWL for Area Sources Input into the CadnaA Model (dBA)

Noise Source	Sound Power Levels (dB)								
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz	Overall Level (dBA)
40 TN Articulated Trucks*	102	108	106	101	100	97	91	82	105

*octave band levels are increased for area sources in order to make up for differences in overall PWLs

There is also a haul road that runs from the approach channel excavation and spur dike construction area to the MIAD staging and disposal areas. Inputs for roadways into the CadnaA model are different than area sources. A road source is input into the CadnaA model using nine trucks going at a speed of 10 mph; and then the road source is calibrated to match the output of the FHWA which calculated out to an SPL of 52.6 dBA L_{eq} at a distance of 50 feet.

2.2.2 Noise Prediction Model Inputs for Construction Activities Conducted During Non-Exempt Hours for Alternative 2

There are several construction activities that have the potential to be conducted during non-exempt hours. Batch plant operations; "dredging activities common to rock"; "drill and shoot and dredging in-the-wet" activities, and the operation of four 1500 cfm compressors during set up and operation of the bubble curtain or silt curtain are all potential activities that may be conducted during non-exempt construction noise hours. Table 21 lists the calculated area source PWLs for all potential nighttime activities for Alternative 2. As stated in the previously mentioned assumptions, there would be only one batch plant used during construction of the Project, but the location of the batch plant has not been determined. For the purpose of analysis of noise impacts for the noise model, the batch plant was modeled at each individual staging area during non-exempt hours in order to see which locations provided the lowest and highest levels of noise exposure during non-exempt construction noise hours. For Alternative 2, a worst-case scenario for activity during non-exempt hours would occur in year 2016 when nighttime batch plant operations and “drill and shoot and dredging of rock in-the-wet” activities are being conducted. “Dredging activities common to rock” could also occur in 2016, but according to the dates listed in the Equipment Estimate Summary that was provided by the USACE, “dredging activities common to rock” and “drill and shoot and dredging rock in-the-wet” activities would occur consecutively; and the noise models assumed that they would not occur simultaneously during non-exempt construction hours.

Table 21. Alternative 2 Proposed Construction Areas and PWLs for Potential Non-Exempt Construction Hour Activities by Year (dBA)

Construction Activity	Area of Construction	2013	2014	2015	2016	2017
Batch Plant	MIAD Staging Area	117.6	117.6	117.6	117.6	117.6
Batch Plant	Dike 7 Staging Area	117.6	117.6	117.6	117.6	117.6
Batch Plant	Overlook Staging Area	117.6	117.6	117.6	117.6	117.6
Batch Plant	Prison Staging Area	117.6	117.6	117.6	117.6	117.6
Dredge Common to Rock	Approach Channel / Spur Dike	n/a	n/a	130.6	130.6	n/a
Drill and Shoot / Dredge Rock Wet	Approach Channel / Spur Dike	n/a	n/a	n/a	131.0	131.0
Set up and Operate Bubble Curtain / Silt Curtain (four 1500 CFM Compressors Only)	Approach Channel / Spur Dike	n/a	n/a	110.4	n/a	n/a

For Alternative 2, in reference to Table 21, the noisiest construction activity that would be conducted outside of construction noise exempt hours would be “drill and shoot and dredging rock in-the-wet” activities in 2016.

2.2.3 Noise Prediction Model Inputs for Construction Activities Conducted During Non-Exempt Hours for Alternatives 3

Table 22 lists the calculated area source PWLs for all potential non-exempt construction hour activities for Alternative 3. For Alternative 3, a worst-case scenario for noise generated by construction activities conducted outside of construction noise exempt hours occurs in year 2013 when batch plant operations and “common dredging below cofferdam" activities are being conducted. This is the highest noise generating construction activity for Alternative 3. Both "dredging common to rock" and "drill and shoot/dredging rock in-the-wet" activities occur in 2017, but it is assumed that these two activities would occur consecutively. Therefore, for Alternative 3, the worst-case year for non-exempt construction noise levels generated by construction activities would occur when batch plant operations and "common dredging below cofferdam" activities are conducted simultaneously in year 2013.

Table 22. Alternative 3 Proposed Construction Areas and PWLs for Potential Non-Exempt Construction Hour Activities by Year (dBA)

Construction Activity	Area of Construction	2013	2014	2015	2016	2017
Batch Plant	MIAD Staging Area	117.6	117.6	117.6	117.6	117.6
Batch Plant	Dike 7 Staging Area	117.6	117.6	117.6	117.6	117.6
Batch Plant	Overlook Staging Area	117.6	117.6	117.6	117.6	117.6
Batch Plant	Prison Staging Area	117.6	117.6	117.6	117.6	117.6
Dewater Behind Cofferdam	Approach Channel / Spur Dike	n/a	130.4	n/a	n/a	n/a
Dredge Common to Rock	Approach Channel / Spur Dike	n/a	n/a	n/a	n/a	130.6
Drill and Shoot / Dredge Rock Wet	Approach Channel / Spur Dike	n/a	n/a	n/a	n/a	130.9
Common Dredge Below Cofferdam	Approach Channel / Spur Dike	131.4	n/a	n/a	n/a	n/a
Set up and Operate Bubble Curtain / Silt Curtain (four 1500 CFM Compressors Only)	Approach Channel / Spur Dike	110.4	n/a	n/a	n/a	n/a

For Alternative 3, in reference to Table 22, the noisiest construction activity that would be conducted outside of construction noise exempt hours would be "common dredging below the cofferdam" activities in 2013. This is the worst-case scenario for construction activities conducted during non-exempt construction noise hours.

2.3 Noise Prediction Model Results

For both Alternatives 2 and 3, worst-case scenarios due to construction activities during construction noise exempt hours were input into the noise model in order to obtain noise levels at long-term (LT-X), short-term (ST-X), modeled (MR-X), and wildlife receivers (Bio-X). MR-1a, MR1b, MR-9 and MR-10 are modeled noise-sensitive receivers. MR-1a is a modeled noise-sensitive receiver located on the north end of Folsom Prison and MR-1b is a modeled noise-sensitive receiver located on the east end of Folsom Prison. MR-9 is located at the eastern-most single-family residence that is located immediately southwest of the MIAD staging area and north of the intersection of Briggs Ranch Drive and East Natoma Street. MR-10 is located at the western end of Lorena Lane and immediately southeast of the Dike 7 staging area. These noise modeling locations are utilized because ambient noise level measurements were not conducted at these locations and, due to the activities at the Dike 7 and MIAD staging areas, it is important to know what type of noise would be generated by construction equipment at the noise modeling locations. The noise levels at the noise-sensitive receivers have been compared to the measured ambient noise levels to see if there would be noise impacts. The same process was also conducted for blasting and construction activities conducted outside of construction noise exempt hours for both Alternatives 2 and 3.

2.3.1 Noise Prediction Model Results for Alternative 2 during Construction Noise Exempt Hours

Under Alternative 2, the worst-case scenario is 2017 as the result of noise levels generated by construction activities during exempt hours. The area sources, and their respective PWLs, found in Table 18, are input into the CadnaA model to generate noise levels at ST, LT, MR, and Bio noise-sensitive sites. The noise contours generated by CadnaA for construction activities conducted during 2017 for Alternative 2 can be found in the DEIS/EIR. Table 23 displays the resulting L_{eq} values at each noise-sensitive receiver. The City of Folsom uses the L_{50} metric as its baseline noise criterion, but comparing the L_{eq} with the L_{50} results is a conservative model because L_{eq} values are always higher than L_{50} values.

Table 23. Measured Ambient Noise Levels and Noise Levels Due to Construction Activities for Alternative 2 in 2017

Site ID	Modeled Noise Level Due to Construction Activities (dBA L_{eq})	L_{50} (ambient noise level in dBA from 7:00 to 18:00 for LTs and daytime L_{50} for Bio and ST)
MR-1a	49	n/a
MR-1b	47	n/a
LT-2	55	66

Table 23. Measured Ambient Noise Levels and Noise Levels Due to Construction Activities for Alternative 2 in 2017

Site ID	Modeled Noise Level Due to Construction Activities (dBA	L_{50} (ambient noise level in dBA from 7:00 to 18:00 for LTs and daytime L_{50} for Bio
LT-3	64	46
LT-4	52	73
LT-5	45	45
LT-6	48	47
ST-7	49	43
ST-8	58	40
MR-9	57	n/a
MR-10	61	n/a
Bio-1	30	42
Bio-2	46	49
Bio-3	34	42
Bio-4	40	51
Bio-5	44	49
Bio-6	46	51
Bio-7	36	41
Bio-8	31	57

2.3.2 Noise Prediction Model Analysis for Alternative 2 during Construction Noise Exempt Hours

Construction activities that would be conducted during construction noise exempt hours in the year 2017 for Alternative 2 of the Project will generate exterior noise levels which exceed significance criteria established by the City of Folsom at several noise-sensitive receivers. The 50 dBA daytime L_{50} noise standard is exceeded at LT-2, LT-3, LT-4, ST-8, MR-9 and MR-10. At LT-2 and LT-4, the modeled L_{eq} is below the measured daytime L_{50} and therefore, there would be no noise impacts at these noise-sensitive receivers. Although the modeled noise levels due to daytime construction activities for Alternative 2 would exceed the L_{50} noise standard and existing ambient daytime L_{50}s at LT-3, ST-8, MR-9, and MR-10, construction noise is exempt from local standards from 7:00 a.m. to 6:00 p.m. during weekdays and from 8:00 a.m. to 5:00 p.m. on weekends. The will be no significant noise impacts if construction activities are conducted within these construction noise exempt times.

If construction activities are conducted in between 6:00 p.m. and 10:00 p.m., then mitigation would be necessary in order to meet the daytime noise standard of 50 dBA L_{50} at all respective noise-sensitive receivers where the modeled L_{eq} is above 50 dBA L_{eq}. If construction activities are conducted in between 10:00 p.m. and 7:00 a.m., then mitigation would be necessary in order to meet the nighttime noise standard of 45 dBA L_{50} at all respective noise-sensitive receivers where the modeled L_{eq} is above 45 dBA L_{eq}.

Noise levels would not exceed 60 dBA L_{eq} at any wildlife receptor site, therefore there are no expected impacts to wildlife habitat.

2.3.3 Noise Prediction Model Results for Alternative 3 during Construction Noise Exempt Hours

Under Alternative 3, the worst-case scenario is 2013 as the result of noise levels generated by construction activities during exempt hours. The area sources, and their respective PWLs, found in Table 19, are input into the CadnaA model to generate noise levels at ST, LT, MR, and Bio noise-sensitive sites. The noise contours generated by CadnaA for construction activities conducted during 2013 for Alternative 3 can be found in the DEIS/EIR. Table 24 displays the resulting L_{eq} values at each noise-sensitive receiver.

Table 24. Measured Ambient Noise Levels and Noise Levels Due to Construction Activities for Alternative 3 in 2013

Site ID	Modeled Noise Level Due to Construction Activities (dBA L_{eq})	L_{50} (ambient noise level in dBA from 7:00 to 18:00 for LTs and daytime L_{50} for Bio and ST)
MR-1a	54	n/a
MR-1b	52	n/a
LT-2	58	66
LT-3	67	46
LT-4	54	73
LT-5	48	45
LT-6	53	47
ST-7	55	43
ST-8	62	40
MR-9	58	n/a
MR-10	63	n/a
Bio-1	35	42
Bio-2	51	49
Bio-3	38	42

Site ID	Modeled Noise Level Due to Construction Activities (dBA	L_{50} (ambient noise level in dBA from 7:00 to 18:00 for LTs and daytime L_{50} for Bio
Bio-4	44	51
Bio-5	48	49
Bio-6	48	51
Bio-7	41	41
Bio-8	36	57

2.3.4 Noise Prediction Model Analysis for Alternative 3 Activities during Construction Noise Exempt Hours

Construction activities that are proposed to be conducted during construction noise exempt hours in the year 2013 for Alternative 3 of the Project would generate exterior noise levels which exceed significance criteria established by the City of Folsom at several noise-sensitive receivers. The 50 dBA daytime L_{50} noise standard is exceeded at MR-1, LT-2, LT-3, LT-4, LT-6, ST-7, ST-8, MR-9, and MR-10. At LT-2 and LT-4, the modeled L_{eq} is below the measured daytime L_{50} and therefore, there would be no noise impacts at these noise-sensitive receivers. Although the modeled noise levels due to daytime construction activities for Alternative 3 would exceed the L_{50} noise standard and existing ambient daytime L_{50}s at MR-1, LT-3, LT-6, ST-7, ST-8, MR-9, and MR-10, construction noise is exempt from local standards from 7:00 a.m. to 6:00 p.m. during weekdays and from 8:00 a.m. to 5:00 p.m. on weekends. There would be no significant noise impacts if construction activities are conducted within these construction noise exempt times.

If construction activities are conducted in between 6:00 p.m. and 10:00 p.m., then mitigation will be necessary in order to meet the daytime noise standard of 50 dBA L_{50} at all respective noise-sensitive receivers where the modeled L_{eq} is above 50 dBA L_{eq}. If construction activities are conducted in between 10:00 p.m. and 7:00 a.m., then mitigation would be necessary in order to meet the nighttime noise standard of 45 dBA L_{50} at all respective noise-sensitive receivers where the modeled L_{eq} is above 45 dBA L_{eq}.

Noise levels would not exceed 60 dBA L_{eq} at any wildlife receptor site, therefore there are no expected impacts to wildlife habitat.

2.3.5 Noise Prediction Model Results and Analysis for Alternative 2 during Non-Exempt Construction Noise Hours

There are several potential construction activities planned for Alternative 2 that may be conducted outside of construction noise exempt times. Batch plant activities would be conducted during non-exempt hours at one of the staging areas, but the location of the batch plant has yet to be determined. Non-exempt batch plant activities may be conducted at any time throughout the construction of the project. For Alternative

2, a worst-case scenario for construction activities conducted outside of construction noise exempt hours occurs in year 2016 when nighttime batch plant operations and “drill and shoot and dredging of rock in-the-wet” activities are conducted simultaneously. Table 25 displays the modeled noise levels at each noise-sensitive receiver due to only batch plant activities being conducted at each individual staging area, “drill and shoot and dredging of rock in-the-wet” activities, and batch plant activities being conducted simultaneously with “drill and shoot and dredging of rock in-the-wet” activities as a worst-case scenario for non-exempt generated construction noise in 2016.

At Folsom Prison (MR-1a and MR-1b), LT-5, and LT-6, the 50 or 45 dBA L_{50} exterior noise standards would not be exceeded due to any of the potential construction activities that may be conducted during non-exempt construction noise hours.

At LT-2, if the batch plant is located at the Dike 7 staging area, the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards would be exceeded if “drill and shoot and dredging in-the-wet” activities are conducted outside of construction noise exempt hours simultaneously with batch plant activities. Batch plant activities alone, at the Dike 7 staging area, would generate noise levels that exceed the 45 dBA L_{50} nighttime exterior noise standard. The 45 dBA L_{50} nighttime exterior noise standard would also be exceeded during non-exempt hours if “drill and shoot and dredging in-the-wet” activities are conducted without any batch plant activities being conducted simultaneously. For all of these potential noise impacts, mitigation would be necessary in order to prevent noise impacts at LT-2 as the result of construction activities being conducted outside of construction noise exempt hours.

At LT-3, the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards would be exceeded during non-exempt construction noise hours if “drill and shoot and dredging in-the-wet” activities are conducted. If batch plant activities are conducted during non-exempt hours at the Dike 7 staging area without any other construction activities taking place, the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards would be exceeded. For all of these potential noise impacts, mitigation would be necessary in order to prevent noise impacts at LT-3 as the result of construction activities being conducted outside of construction noise exempt hours.

At LT-4, the 45 dBA L_{50} nighttime exterior noise standard would be exceeded during non-exempt construction hours if batch plant activities are being conducted at the MIAD staging area. Mitigation would be necessary in order to prevent noise impacts at LT-4 if batch plant activities are conducted outside of construction noise exempt hours and occur from 10:00 p.m. and 7:00 a.m.

Table 25. Alternative 2 Modeled Noise Levels Due to Construction Activities Being Conducted during Non-Exempt Construction Noise Hours (dBA L_{eq})

Site ID	MIAD Batch Plant	Dike 7 Batch Plant	Overlook Batch Plant	Prison Batch Plant	Drill and Shoot and Dredging In-the-Wet	MIAD Batch Plant w/ Drill and Shoot / Dredging In-the-Wet	Dike 7 Batch Plant w/ Drill and Shoot / Dredging In-the-Wet	Overlook Batch Plant w/ Drill and Shoot / Dredging In-the-Wet	Prison Batch Plant w/ Drill and Shoot / Dredging In-the-Wet
MR-1a	22	33	34	33	44	44	44	44	44
MR-1b	17	31	32	28	41	41	42	42	42
LT-2	31	48	30	26	47	47	50	47	47
LT-3	33	59	40	29	55	55	60	55	55
LT-4	46	21	26	16	41	47	41	41	41
LT-5	36	24	23	17	37	39	37	37	37
LT-6	21	26	32	37	43	43	43	43	44
ST-7	19	22	35	27	45	45	45	45	45
ST-8	42	33	36	24	51	51	51	51	51
MR-9	51	32	29	22	44	52	44	44	44
MR-10	25	57	34	27	49	49	58	49	49
Bio-1	10	12	13	13	25	25	25	25	25
Bio-2	11	22	29	35	41	41	41	41	42
Bio-3	13	15	16	15	28	29	29	29	29
Bio-4	24	24	20	17	34	34	34	34	34
Bio-5	32	27	23	17	37	38	37	37	37
Bio-6	38	26	23	18	37	40	37	37	37
Bio-7	24	19	16	14	30	31	30	30	30
Bio-8	9	11	14	13	27	27	27	27	27

At ST-7, the 45 dBA L_{50} nighttime exterior noise standard would be exceeded during non-exempt construction hours if “drill and shoot and dredging in-the-wet” activities are conducted. Mitigation would be necessary in order to prevent noise impacts at ST-7 as the result of construction activities being conducted outside of construction noise exempt hours.

At ST-8 (Folsom Point), the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards would be exceeded during non-exempt construction noise hours if “drill and shoot and dredging in-the-wet” activities are conducted. ST-8 is modeled near the north end of the parking lot and, although Table 25 indicates a modeled 42 dBA L_{eq} from batch plant activities at the MIAD staging area, there may be higher levels of noise at other areas of the Folsom Point that may exceed the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards if batch plant activities are conducted outside of construction noise exempt times. However, since Folsom Point is a day-use facility, it is assumed that recreationists would not be present during non-exempt hours, and this effect is consisted less than significant.

At MR-9, the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards would be exceeded during non-exempt construction noise hours if batch plant activities are conducted at the MIAD staging area. Mitigation would be necessary in order to prevent noise impacts at MR-9 as the result of batch plant activities being conducted outside of construction noise exempt hours.

At MR-10, if the batch plant is located at the Dike 7 staging area, the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards would be exceeded during non-exempt construction noise hours. If “drill and shoot and dredging in-the-wet” activities are conducted outside of construction noise exempt hours, the 45 dBA L_{50} nighttime noise standard would be exceeded. For all of these potential noise impacts, mitigation would be necessary in order to prevent noise impacts at MR-10 as the result of construction activities being conducted outside of construction noise exempt hours.

Noise levels would not exceed 60 dBA L_{eq} at any wildlife receptor site, therefore there are no expected impacts to wildlife habitat during non-exempt construction noise hours.

2.3.6 Noise Prediction Model Results and Analysis for Alternative 3 Non-Exempt Construction Noise Hours Activities

There are several potential construction activities planned for Alternative 3 that may be conducted outside of construction noise exempt times. Batch plant activities would be conducted during non-exempt hours at one of the staging areas, but the location of the batch plant has yet to be determined. Non-exempt batch plant activities may potentially be conducted at any time throughout the construction of the project. For Alternative 3, a worst-case scenario for construction activities being conducted outside of construction noise exempt hours would occur in year 2013 when nighttime batch plant operations and common dredging below cofferdam activities are conducted simultaneously. Table 26 displays the modeled noise levels at each noise-sensitive receiver due to only batch plant activities being conducted at each individual staging area, “common dredging below cofferdam” activities, and batch plant activities being conducted simultaneously with “common dredging below cofferdam” activities as a worst-case scenario for non-exempt generated construction noise in 2013.

At Folsom Prison (MR-1a and MR-1b), LT-5, and LT-6, the 50 or 45 dBA L_{50} exterior noise standards would not be exceeded due to any of the potential construction activities that may be conducted during non-exempt construction noise hours.

Table 26. Alternative 3 Modeled Noise Levels Due to Construction Activities Being Conducted during Non-Exempt Construction Noise Hours (dBA L_{eq})

Site ID	MIAD Batch Plant	Dike 7 Batch Plant	Overlook Batch Plant	Prison Batch Plant	Common Dredge Below Cofferdam	MIAD Batch Plant w/ Common Dredge Below Cofferdam	Dike 7 Batch Plant w/ Common Dredge Below Cofferdam	Overlook Batch Plant w/ Common Dredge Below Cofferdam	Prison Batch Plant w/ Common Dredge Below Cofferdam
MR-1a	22	33	34	33	44	44	44	44	44
MR-1b	17	31	32	28	42	42	42	42	42
LT-2	31	48	30	26	47	47	50	47	47
LT-3	33	59	40	29	56	56	60	56	56
LT-4	46	21	26	16	41	47	41	41	41
LT-5	36	24	23	17	37	40	38	37	37
LT-6	21	26	32	37	43	43	43	44	44
ST-7	19	22	35	27	45	45	45	45	45
ST-8	42	33	36	24	51	52	51	51	51
MR-9	51	32	29	22	44	52	45	44	44
MR-10	25	57	34	27	49	49	58	49	49
Bio-1	10	12	13	13	26	26	26	26	26
Bio-2	11	22	29	35	41	41	41	41	42
Bio-3	13	15	16	15	29	29	29	29	29
Bio-4	24	24	20	17	34	35	35	34	34
Bio-5	32	27	23	17	37	38	38	37	37
Bio-6	38	26	23	18	37	41	37	37	37
Bio-7	24	19	16	14	31	31	31	31	31
io-8	9	11	14	13	27	27	27	27	27

At LT-2, if the batch plant is located at the Dike 7 staging area, the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards would be exceeded if “common dredging below cofferdam” activities are conducted outside of construction noise exempt hours simultaneously with batch plant activities. Batch plant activities alone, at the Dike 7 staging area, will generate noise levels that exceed the 45 dBA L_{50} nighttime exterior noise standard. The 45 dBA L_{50} nighttime exterior noise standard would also be exceeded during non-exempt hours if “common dredging below cofferdam” activities are conducted without any batch plant activities being conducted simultaneously. For all of these potential noise impacts, mitigation would be necessary in order to prevent noise impacts at LT-2 as the result of construction activities being conducted outside of construction noise exempt hours.

At LT-3, the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards would be exceeded during non-exempt construction noise hours if “common dredging below cofferdam” activities are conducted. If batch plant activities are conducted during non-exempt hours at the Dike 7 staging area without any other construction activities taking place, the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards would be exceeded. For all of these potential noise impacts, mitigation would be necessary in order to prevent noise impacts at LT-3 as the result of construction activities being conducted outside of construction noise exempt hours.

At LT-4, the 45 dBA L_{50} nighttime exterior noise standard would be exceeded during non-exempt construction hours if batch plant activities are conducted at the MIAD staging area. Mitigation would be necessary in order to prevent noise impacts at LT-4 if batch plant activities are conducted outside of construction noise exempt hours and occur from 10:00 p.m. and 7:00 a.m.

At ST-7, the 45 dBA L_{50} nighttime exterior noise standard would be exceeded during non-exempt construction hours if “common dredging below cofferdam” activities are conducted. Mitigation would be necessary in order to prevent noise impacts at ST-7 as the result of construction activities being conducted outside of construction noise exempt hours.

At ST-8 (Folsom Point), the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards would be exceeded during non-exempt construction noise hours if “common dredging below cofferdam” activities are conducted. ST-8 is modeled near the north end of the parking lot and, although Table 26 indicates a modeled 42 dBA L_{eq} generated by batch plant activities at the MIAD staging area, there may be higher levels of noise at other areas of the Folsom Point that may exceed the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards if batch plant activities are conducted outside of construction noise exempt times. However, since Folsom Point is a day-use facility, it is assumed that recreationists would not be present during non-exempt hours. As a result, this effect is considered less than significant.

At MR-9, the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards would be exceeded during non-exempt construction noise hours if batch plant activities are conducted at the MIAD staging area and if “common dredging below cofferdam” activities are conducted simultaneously with batch plant activities at the

MIAD staging area, then the 45 dBA L_{50} nighttime exterior noise standard will be exceeded. For all of these potential noise impacts, mitigation would be necessary in order to prevent noise impacts at MR-9 as the result of construction activities being conducted outside of construction noise exempt hours.

At MR-10, if the batch plant is located at the Dike 7 staging area, the 50 dBA L_{50} daytime and 45 dBA L_{50} nighttime exterior noise standards would be exceeded during non-exempt construction noise hours. If "common dredging below cofferdam" activities are conducted outside of construction noise exempt hours, the 45 dBA L_{50} nighttime noise standard would be exceeded. For all of these potential noise impacts, mitigation would be necessary in order to prevent noise impacts at MR-10 as the result of construction activities being conducted outside of construction noise exempt hours.

Noise levels would not exceed 60 dBA L_{eq} at any wildlife receptor site, therefore there are no expected impacts to wildlife habitat during non-exempt construction noise hours.

2.3.7 Noise Prediction Model Results and Analysis for Blasting Activities

A noise modeling program known as BNoise2 is used in order to determine the sound power level of an individual blast. Assumptions are made based on data provided by the USACE and information in Appendix E (Technical Noise Report) of the 2010 EA/IS for the Joint Federal Project for the Construction of the Control Structure and Lining of the Spillway Chute and Stilling Basin. The following assumptions are:

- There would be approximately 400 blasts in-the-wet and 200 blasts in-the-dry from February 2014 to August 2017 (approximately 1,100 days of work) for Alternative 2. This results in an approximately one blast every other day
- There would be approximately 200 blasts in-the-wet and 280 blasts in-the-dry from February 2014 to August 2017 (approximately 1,100 days of work) for Alternative 3. This results in approximately one blast every other day
- Ammonium nitrate and fuel oil (ANFO) charges would be used
- A charge weight of 44 pounds would be packed in 20-foot deep borings
- The borings would be spaced 5 feet apart in a 20-foot-wide bench
- The most charges that would be used during any blast is 75 charges

Using the assumptions above, BNoise2 calculated a SPL of 84.5 dBC SEL at 328 feet for one charge. If 75 charges are used, the PWL would be 141.2 dBA at 328 feet. This PWL is input into the CadnaA model at the approach channel excavation area in order to account for changes in topography. Table 27 shows the resulting SELs at each noise-sensitive receiver.

Table 27. Noise Levels at Noise-Sensitive Receivers due to Individual Blasts

Site ID	Noise Level due to Individual Blast (dBA SEL)
MR-1a	54
MR-1b	50
LT-2	48
LT-3	60
LT-4	45
LT-5	51
LT-6	57
ST-7	60
ST-8	59
MR-9	54
MR-10	51
Bio-1	40
Bio-2	55
Bio-3	43
Bio-4	41
Bio-5	45
Bio-6	50
Bio-7	44
Bio-8	44

Blasting would be conducted during construction noise exempt hours and would only be at the noise levels listed in Table 27 for no more than a few seconds. This would not significantly increase any of the modeled L_{eq}s for other construction noise exempt hour activities. There would be no noise impacts at human or wildlife noise-sensitive receivers due to blasting.

2.3.8 Noise Impacts on Fish

Potential Impacts on Fish. As identified previously, underwater sound from blasting and pile driving has the potential to impact fish inhabiting Folsom Lake. Noise potentially causes both auditory and non-auditory effects on fish. The non-auditory effects of noise may be obvious, for instance when an underwater detonation of explosives results in floating dead fish. Other injuries, such as swim bladder rupture in fish, may be shown only by dissection of exposed individuals. These adverse impacts only occur at high levels of sound, typically within tens, or at most a few hundred meters of underwater blasts, and hence affect relatively small areas and numbers of individuals (Nedwell and Edwards 2004).

The auditory effects of sound include temporary or permanent noise-induced deafness. Behavioral effects elicited by underwater noise can include a startle reaction or a species avoiding an area of high noise. Such responses are poorly understood or documented, yet behavioral effects may have an influence over great ranges, often kilometers, reaching much larger numbers of individuals. Fish response to sound can also be varied, ranging from the classic fright response that results in a startle behavior and sudden burst of short duration and distance swimming, to other responses such as packing or balling, polarizing, increasing swimming speed, diving, or avoidance (Olsen 1969).

Extremely loud sound levels can have very negative effects on fish including temporary or permanent deafness, tissue damage, and even acute mortality. The most severe instances, often associated with explosive sources, result from a high amplitude shock wave caused by the initial impulse and the negative pressure wave reflected by the water surface (Turnpenny and Nedwell 1994; Houghton and Munday 1987). Tissue damage arises when the wave passes through tissues of different densities. A wave passed through the tissues at different speeds can result in a shear environment, and in extreme cases the tissues can be torn apart. This is most severe where tissue density differences are the greatest, which in the case of demersal fish, is at the muscle - swim bladder interface (Turnpenny and Nedwell 1994).

This physical trauma, often termed barotrauma, has a direct impact on the fish and health of the fish. The degree of this impact has been characterized as a numerical scale (O'Keefe and Young 1984; based on an earlier scale developed by Hubbs et al. 1960). These numerical explosion damage criteria for fish cover the range of gross visible effects from exposure to large high amplitude shockwaves:

1. No damage (fish survives)
2. Light hemorrhaging (fish survives)
3. Light hemorrhaging and some kidney damage (impaired escape response and possible increased vulnerability to predation)
4. Swimbladder bursts and gross kidney damage (fish killed)
5. Incomplete body wall break and gross internal damage (fish killed)
6. Complete rupture of body cavity and organ destruction (fish killed)

While this range is diagnostic for direct trauma due to high amplitude shockwaves, it also applies for high intensity sound waves generated by other sources such as impact pile driving.

This definition of direct effects also implies indirect effects to fish due to noise impacts. These indirect effects usually manifest themselves as a reduction in the ability to evade predation (stunning, or reduced swimming ability), a change in behavior that leads to increased exposure to predation (inability to access a refuge habitat), or an inability to detect predators or prey effectively (temporary or permanent deafness).

The underwater sound levels associated with blasting depends on the size of the charge.

Blasting In-the-Wet. Wet blasting will generate very little airborne noise, but has the potential to kill fish in Folsom Lake. It is likely that some fish will be killed during wet blasting. Recommended mitigation procedures are described in the mitigation section.

Drilling In-the-Wet. Drilling generates noise from both the drill bit striking the rock near the collar of the holes, as well as from mechanical equipment and compressors used on the drills. If the drilling occurs with three or more feet of water, noise made from drill bit striking the rock will be almost immeasurable in air. Drilling from platforms will not occur in less than 35 feet of water, and thus is not expected to generate measurable noise in air. It is likely that some fish will be disturbed during drilling, but underwater sound levels are not expected to result in injury or death to fish.

2.4 Mitigation

The following measures would be implemented in order to reduce noise effects in the vicinity of construction for the project and in order to attempt to meet the respective daytime and nighttime exterior noise standards of 50 and 45 dBA L_{50}. Mitigation measures would be implemented to reduce noise from the following activities outside of noise exempt hours: batch plant operations, “dredging activities common to rock”, “drill and shoot and dredging in-the-wet” activities, activities relating to four 1,500 cfm compressors running during “set up and operation of the bubble and/or silt curtain”, “common dredging below cofferdam” activities, and “dewatering” activities behind the cofferdam. , Mitigation measures would include:

- Conduct construction activities during construction noise exempt hours
- For construction activities being conducted outside of construction noise exempt hours, the Contractor will obtain a permit from the City and County
- Contractor will be responsible for maintaining equipment in best possible working condition
- Each piece of construction equipment should be fitted with efficient, well-maintained mufflers that reduce equipment noise emissions in order to reduce noise emission levels from equipment and vehicles at the project site
- Schedule truck loading, unloading, and hauling operations so as to reduce noise levels due to construction during non-exempt construction hours
- Locate construction equipment as far as possible from nearby noise-sensitive receptors
- Situate construction equipment so that natural berms or aggregate stockpiles are located in between the equipment and noise-sensitive receptors
- Enclose pumps that are not submerged and enclose above-ground conveyor systems in acoustically treated enclosures

- Lining or covering hoppers, conveyor transfer points, storage bins and chutes with sound-deadening material
- Acoustically attenuating shielding (barriers) and shrouds should be used when possible
- Using blast mats to cover blasts in order to minimize the possibility of fly rock
- Use of bubble curtains around under water blasting activities

If all of these mitigation procedures are put into practice for Alternatives 2 and 3, there is still the potential for construction activities that are conducted during non-exempt hours to exceed the daytime and nighttime noise standards at noise-sensitive receptors.

Specific mitigation measures should be utilized in order to reduce noise levels from blasting. The BMPs listed below assume use of the standard practice of linear (rather than spherical) charges, and standard timing separation of 8 milliseconds to reduce cumulative effects between adjacent charges. BMPs include:

- Designing efficient detonations (“blast design”) that fracture the rock with minimal energy released to surrounding water.[1] Efficient detonations are achieved by:
    - Establishing a not-to-exceed peak pressure-change (over-pressure) limit of 100kPa (14.5 psi).
    - Controlling maximum pressure thresholds by establishing cautious charge confinement rules regarding the type and amount of stemming[2] (material placed in the upper portions of blast holes), and the amount of confining rock burden between charges and the free or open face to which they break.
    - Monitoring peak blast-induced pressure and impulse;
    - Requiring the use of multiple time-sequenced charges that will reduce the cumulative impacts on the water environment;
    - Timing blasting when fish tend to be in streams in northern tributaries far from the blast site, e.g., February through June for rainbow trout; the timing of spawning of Chinook salmon in Folsom Lake is not well characterized.
    - Setting off small charges (“scare charges”) or firing air-cannons into the water before blasting to chase fish from the blast area;

[1] The use of stemming to confine blasts, results in several typically listed BMPs becoming less necessary to minimize the impact of the underwater blast on fish. Stemming is used to control extreme peak pressures spikes released in the water. Another method of removing steep peak pressure spikes is to specify the burn rate of the exploding charge or Velocity of Detonation (VOD) which impacts the relative amounts of gas versus shock energy. Specifying the explosive properties, therefore, is not necessary as a BMP when proper stemming is utilized.

[2] Stemming is the practice of placing inert material on the top of the charge to help confine the energy released by the charge to the material to be demolished, and reduce the energy released to the water or air.

  - o Grouping continuous periods of noisy work or simultaneous noisy work (e.g., multiple drill barges) to prevent the fish from re-entering the area during short quiet periods);
  - o Using air curtains or bubble curtains to attenuate pressure waves. Air supply to bubble pipes would be provided by clean-air compressors that contain no oil or other contaminants.
  - o Not using ammonium nitrate-fuel oil mixtures (ANFO) in or near water because they will not function as desired and if released into water they will dissolve and release toxic by-products (ammonia and nitrates)

- For drilling activities in the water, BMP's include the use of down-the-hole-hammers, which produce much less noise than top-hammer drills from the striking bar.

2.5 Cumulative

There is the potential for future construction activities that are conducted concurrently throughout the life of the Folsom Dam JFP and involved with other projects in the vicinity of the Project to temporarily increase noise levels in the surrounding areas. The projects include:

- Johnny Cash Folsom Prison Blues Trail: Historic Truss Bridge to Green Valley Road Segment
- Raw Water Bypass Pipeline Project
- Central California Area Office Building Replacement Project
- Lower American River Salmonid Spawning Gravel Augmentation and Side-channel Habitat Establishment Program
- Folsom Dam Safety and Flood Damage Reduction Project Ongoing Construction Activities
- Widening of Green Valley Road
- Folsom Dam Raise

Simultaneous construction of these projects would increase noise levels, from onsite construction and transport of materials. The worst case assumption indicates that simultaneous construction could potentially increase source noise emissions by 3 dBA. If these construction projects are implemented concurrently, the combined cumulative effects could be above significance thresholds. If this were the case, each project would need to mitigate individual noise effects which could decrease overall cumulative effects. However, without consideration of scheduling and sequence of activities, determination of whether concurrent construction projects within and adjacent to Folsom Lake could have significant cumulative noise effects is not possible. Construction involved with both the Folsom Dam JFP and the projects listed above are temporary in nature and, therefore, there would be no cumulative noise effects other than increases in noise levels during simultaneous construction activities.

2.6 Summary/Conclusion

The largest noise impacts from the proposed Project are due to construction activities being conducted outside of construction noise exempt hours. The only construction activities that would potentially be conducted during non-exempt construction noise hours that would not exceed noise significance criteria would be if batch plants activities were conducted at either the Overlook or Prison staging areas with no other construction taking place at the approach channel excavation and spur dike construction areas. Most construction activities that would potentially be conducted during non-exempt construction noise hours for Alternatives 2 and 3 would exceed the City of Folsom's daytime and nighttime exterior noise standards of 50 and 45 dBA L_{50} at some of the noise-sensitive receivers. If the batch plant is located at the MIAD or Dike 7 staging areas and they are the only activities being conducted outside of construction noise exempt hours, then there would still be noise impacts at noise-sensitive receivers. Other activities conducted outside of construction noise exempt hours at the approach channel excavation and spur dike construction areas would generate noise impacts at some noise-sensitive receivers with or without batch plant activities being conducted simultaneously. Mitigation would be necessary in order to reduce noise impacts, but even with mitigation, there is the potential for noise impacts outside of construction noise exempt hours.

Noise levels would not exceed the 60 dBA L_{eq} at wildlife receptor sites. There are no expected noise impacts.

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LT-2 (Tacana Drive and E. Natoma St.)

Date	Start Time	End Time	Hourly L_{eq} (dBA)
3/25/2009	17:00:00	18:00:00	68.9
3/25/2009	18:00:00	19:00:00	68.4
3/25/2009	19:00:00	20:00:00	67.8
3/25/2009	20:00:00	21:00:00	65.9
3/25/2009	21:00:00	22:00:00	65.7
3/25/2009	22:00:00	23:00:00	62.9
3/25/2009	23:00:00	0:00:00	60.0
3/26/2009	0:00:00	1:00:00	56.6
3/26/2009	1:00:00	2:00:00	56.9
3/26/2009	2:00:00	3:00:00	51.5
3/26/2009	3:00:00	4:00:00	58.8
3/26/2009	4:00:00	5:00:00	57.1
3/26/2009	5:00:00	6:00:00	63.8
3/26/2009	6:00:00	7:00:00	67.6
3/26/2009	7:00:00	8:00:00	68.3
3/26/2009	8:00:00	9:00:00	69.4
3/26/2009	9:00:00	10:00:00	68.4
3/26/2009	10:00:00	11:00:00	67.8
3/26/2009	11:00:00	12:00:00	69.0
3/26/2009	12:00:00	13:00:00	68.1
3/26/2009	13:00:00	14:00:00	68.6
3/26/2009	14:00:00	15:00:00	69.1
3/26/2009	15:00:00	16:00:00	68.8
3/26/2009	16:00:00	17:00:00	69.4

LT-3 (Mountain View Dr.)

Date	Start Time	End Time	Hourly L_{eq} (dBA)
3/24/2009	15:00:00	16:00:00	47.5
3/24/2009	16:00:00	17:00:00	46.3
3/24/2009	17:00:00	18:00:00	48.7
3/24/2009	18:00:00	19:00:00	45.7
3/24/2009	19:00:00	20:00:00	43.1
3/24/2009	20:00:00	21:00:00	42.2
3/24/2009	21:00:00	22:00:00	42.1
3/24/2009	22:00:00	23:00:00	41.1
3/24/2009	23:00:00	0:00:00	40.7
3/25/2009	0:00:00	1:00:00	35.9
3/25/2009	1:00:00	2:00:00	34.7
3/25/2009	2:00:00	3:00:00	32.8
3/25/2009	3:00:00	4:00:00	34.3
3/25/2009	4:00:00	5:00:00	37.6
3/25/2009	5:00:00	6:00:00	42.0
3/25/2009	6:00:00	7:00:00	46.4
3/25/2009	7:00:00	8:00:00	49.9
3/25/2009	8:00:00	9:00:00	50.6
3/25/2009	9:00:00	10:00:00	47.6
3/25/2009	10:00:00	11:00:00	47.9
3/25/2009	11:00:00	12:00:00	49.5
3/25/2009	12:00:00	13:00:00	50.5
3/25/2009	13:00:00	14:00:00	50.9
3/25/2009	14:00:00	15:00:00	50.7

LT-4 (E. Natoma St. and Green Valley Rd.)

Date	Start Time	End Time	Hourly L_{eq} (dBA)
3/24/2009	14:00:00	15:00:00	73.8
3/24/2009	15:00:00	16:00:00	73.9
3/24/2009	16:00:00	17:00:00	74.1
3/24/2009	17:00:00	18:00:00	74.1
3/24/2009	18:00:00	19:00:00	73.8
3/24/2009	19:00:00	20:00:00	72.2
3/24/2009	20:00:00	21:00:00	71.2
3/24/2009	21:00:00	22:00:00	71.2
3/24/2009	22:00:00	23:00:00	68.1
3/24/2009	23:00:00	0:00:00	65.4
3/25/2009	0:00:00	1:00:00	62.5
3/25/2009	1:00:00	2:00:00	61.0
3/25/2009	2:00:00	3:00:00	58.0
3/25/2009	3:00:00	4:00:00	60.1
3/25/2009	4:00:00	5:00:00	65.1
3/25/2009	5:00:00	6:00:00	70.1
3/25/2009	6:00:00	7:00:00	73.2
3/25/2009	7:00:00	8:00:00	75.2
3/25/2009	8:00:00	9:00:00	75.0
3/25/2009	9:00:00	10:00:00	73.3
3/25/2009	10:00:00	11:00:00	73.5
3/25/2009	11:00:00	12:00:00	73.1
3/25/2009	12:00:00	13:00:00	72.9
3/25/2009	13:00:00	14:00:00	74.1

LT-5 (Shadowfax Court)

Date	Start Time	End Time	Hourly L_{eq} (dBA)
3/24/2009	13:00:00	14:00:00	50.9
3/24/2009	14:00:00	15:00:00	46.0
3/24/2009	15:00:00	16:00:00	49.0
3/24/2009	16:00:00	17:00:00	48.9
3/24/2009	17:00:00	18:00:00	50.8
3/24/2009	18:00:00	19:00:00	57.5
3/24/2009	19:00:00	20:00:00	48.5
3/24/2009	20:00:00	21:00:00	47.9
3/24/2009	21:00:00	22:00:00	49.0
3/24/2009	22:00:00	23:00:00	41.4
3/24/2009	23:00:00	0:00:00	39.8
3/25/2009	0:00:00	1:00:00	39.5
3/25/2009	1:00:00	2:00:00	34.1
3/25/2009	2:00:00	3:00:00	36.4
3/25/2009	3:00:00	4:00:00	33.1
3/25/2009	4:00:00	5:00:00	37.1
3/25/2009	5:00:00	6:00:00	44.1
3/25/2009	6:00:00	7:00:00	50.2
3/25/2009	7:00:00	8:00:00	50.1
3/25/2009	8:00:00	9:00:00	49.3
3/25/2009	9:00:00	10:00:00	44.9
3/25/2009	10:00:00	11:00:00	44.0
3/25/2009	11:00:00	12:00:00	43.3
3/25/2009	12:00:00	13:00:00	45.7

LT-6 (East of Folsom Auburn Rd. and Pierpoint Circle)

Date	Start Time	End Time	Hourly L_{eq} (dBA)
3/24/2009	15:00:00	16:00:00	56.8
3/24/2009	16:00:00	17:00:00	54.5
3/24/2009	17:00:00	18:00:00	49.6
3/24/2009	18:00:00	19:00:00	40.8
3/24/2009	19:00:00	20:00:00	47.1
3/24/2009	20:00:00	21:00:00	45.9
3/24/2009	21:00:00	22:00:00	41.6
3/24/2009	22:00:00	23:00:00	38.2
3/24/2009	23:00:00	0:00:00	35.7
3/25/2009	0:00:00	1:00:00	34.4
3/25/2009	1:00:00	2:00:00	35.4
3/25/2009	2:00:00	3:00:00	31.7
3/25/2009	3:00:00	4:00:00	36.4
3/25/2009	4:00:00	5:00:00	33.5
3/25/2009	5:00:00	6:00:00	38.2
3/25/2009	6:00:00	7:00:00	41.5
3/25/2009	7:00:00	8:00:00	45.9
3/25/2009	8:00:00	9:00:00	49.0
3/25/2009	9:00:00	10:00:00	45.4
3/25/2009	10:00:00	11:00:00	51.1
3/25/2009	11:00:00	12:00:00	49.1
3/25/2009	12:00:00	13:00:00	48.8
3/25/2009	13:00:00	14:00:00	51.0
3/25/2009	14:00:00	15:00:00	52.7

Site ID	Location	Start Date	Start Time (10 min. Meas.)	L_{eq} (dBA)	L_{max} (dBA)	L_{min} (dBA)	L90 (dBA)	L50 (dBA)	L10 (dBA)
ST-2	Tacana Dr. and E. Natoma St.	3/25/2009	16:40:00	66.2	79.5	39.6	47.4	63.8	69.9
ST-2	Tacana Dr. and E. Natoma St.	3/25/2009	16:50:00	67.7	86.8	40.7	52.2	64.7	71.1
ST-2	Tacana Dr. and E. Natoma St.	3/25/2009	20:28:00	63.0	79.7	39.2	45.3	53.3	67.2
ST-2	Tacana Dr. and E. Natoma St.	3/25/2009	20:39:00	62.4	78.5	41.9	45.5	55.1	66.7
ST-2	Tacana Dr. and E. Natoma St.	3/26/2009	0:11:00	53.0	71.3	31.9	34.7	38.3	53.0
ST-2	Tacana Dr. and E. Natoma St.	3/26/2009	0:21:00	53.6	72.4	32.6	35.1	38.7	53.0
ST-3	Mountain View Dr.	3/24/2009	17:25:00	45.1	61.0	36.1	39.6	42.9	47.6
ST-3	Mountain View Dr.	3/24/2009	17:35:00	46.1	60.7	39.2	41.7	44.5	48.7
ST-3	Mountain View Dr.	3/24/2009	20:40:00	41.1	53.7	35.5	37.9	40.5	43.3
ST-3	Mountain View Dr.	3/24/2009	20:51:00	40.1	57.6	34.5	36.6	39.3	42.1
ST-3	Mountain View Dr.	3/24/2009	22:49:00	40.7	55.8	33.3	35.9	39.5	43.7
ST-3	Mountain View Dr.	3/24/2009	22:59:00	39.0	54.3	33.2	35.4	37.5	41.4
ST-4	E. Natoma St. and Green Valley Rd.	3/24/2009	17:52:00	70.5	87.3	44.9	55.6	69.2	73.8
ST-4	E. Natoma St. and Green Valley Rd.	3/24/2009	18:02:00	70.8	79.8	51.6	60.1	69.6	74.1
ST-4	E. Natoma St. and Green Valley Rd.	3/24/2009	21:08:00	69.4	83.4	47.2	57.8	67.2	73.0

Site ID	Location	Start Date	Start Time (10 min. Meas.)	L_{eq} (dBA)	L_{max} (dBA)	L_{min} (dBA)	L90 (dBA)	L50 (dBA)	L10 (dBA)
ST-4	E. Natoma St. and Green Valley Rd.	3/24/2009	21:18:00	69.6	84.4	46.7	57.2	67.0	73.6
ST-4	E. Natoma St. and Green Valley Rd.	3/24/2009	23:46:00	60.4	75.2	31.8	36.0	46.5	65.4
ST-4	E. Natoma St. and Green Valley Rd.	3/24/2009	23:56:00	62.8	81.4	31.4	36.3	47.6	66.5
ST-5	Shadowfax Ct.	3/24/2009	18:18:00	60.9	78.4	43.3	47.3	50.9	59.8
ST-5	Shadowfax Ct.	3/24/2009	18:28:00	52.4	71.3	43.2	45.6	48.4	51.3
ST-5	Shadowfax Ct.	3/24/2009	21:34:00	47.4	62.7	40.9	44.2	46.9	49.4
ST-5	Shadowfax Ct.	3/24/2009	21:45:00	50.7	62.8	40.7	44.0	46.8	53.0
ST-5	Shadowfax Ct.	3/24/2009	23:18:00	41.7	70.6	30.7	34.9	38.7	42.7
ST-5	Shadowfax Ct.	3/24/2009	23:29:00	41.3	60.5	31.5	35.8	39.6	44.2
ST-6	East of Folsom Auburn Rd. and Robin Ln.	3/25/2009	15:19:00	50.2	64.8	36.6	40.1	44.3	55.0
ST-6	East of Folsom Auburn Rd. and Robin Ln.	3/25/2009	15:29:00	50.9	72.9	41.1	45.4	48.8	53.6
ST-6	East of Folsom Auburn Rd. and Robin Ln.	3/25/2009	19:52:00	40.6	60.6	32.3	34.7	36.9	42.1
ST-6	East of Folsom Auburn Rd. and Robin Ln.	3/25/2009	20:02:00	42.6	59.9	35.0	38.3	40.7	45.4
ST-6	East of Folsom Auburn Rd. and Robin Ln.	3/25/2009	23:31:00	35.4	51.7	31.2	32.6	34.2	37.1
ST-6	East of Folsom Auburn Rd. and Robin Ln.	3/25/2009	23:41:00	34.9	47.6	29.6	31.1	32.8	36.1
ST-7	Beals Point (Campground)	3/24/2009	15:11:00	48.9	71.1	38.0	40.8	43.2	51.1
ST-7	Beals Point (Campground)	3/24/2009	15:22:00	49.0	79.2	35.9	39.1	42.2	46.4
ST-8	Folsom Point	3/24/2009	16:57:00	43.7	57.7	34.8	37.1	39.6	47.7
ST-8	Folsom Point	3/24/2009	17:07:00	41.3	52.8	35.6	37.5	39.1	44.7
ST-8	Folsom Point	3/24/2009	20:12:00	41.3	61.8	31.3	35.5	37.6	40.1

Site ID	Location	Start Date	Start Time (10 min. Meas.)	L_{eq} (dBA)	L_{max} (dBA)	L_{min} (dBA)	L90 (dBA)	L50 (dBA)	L10 (dBA)
ST-8	Folsom Point	3/24/2009	20:22:00	40.9	54.1	31.7	34.0	36.7	45.7

Site ID	Location	Start Date	Start Time (10 min. Meas.)	L_{eq} (dBA)	L_{max} (dBA)	L_{min} (dBA)	L90 (dBA)	L50 (dBA)	L10 (dBA)
BIO-1	Main St.	3/25/2009	10:51:00	44.1	62.6	35.4	38.3	41.6	46.8
BIO-1	Main St.	3/25/2009	19:26:00	48.8	65.4	31.9	37.8	44.3	52.3
BIO-1	Main St.	3/25/2009	22:53:00	44.2	59.6	34.0	36.9	40.4	48.2
BIO-2	East of Folsom Auburn Rd. and Robin Ln.	3/25/2009	15:19:00	50.2	64.8	36.6	40.1	44.3	55.0
BIO-2	East of Folsom Auburn Rd. and Robin Ln.	3/25/2009	15:29:00	50.9	72.9	41.1	45.4	48.8	53.6
BIO-2	East of Folsom Auburn Rd. and Robin Ln.	3/25/2009	19:52:00	40.6	60.6	32.3	34.7	36.9	42.1
BIO-2	East of Folsom Auburn Rd. and Robin Ln.	3/25/2009	20:02:00	42.6	59.9	35.0	38.3	40.7	45.4
BIO-2	East of Folsom Auburn Rd. and Robin Ln.	3/25/2009	23:31:00	35.4	51.7	31.2	32.6	34.2	37.1
BIO-2	East of Folsom Auburn Rd. and Robin Ln.	3/25/2009	23:41:00	34.9	47.6	29.6	31.1	32.8	36.1
BIO-3	Erwin Ave. and Snipes Blvd.	3/25/2009	10:30:00	43.4	59.5	36.8	39.1	42.2	45.8
BIO-3	Erwin Ave. and Snipes Blvd.	3/25/2009	19:08:00	44.8	65.4	34.0	36.1	37.9	45.1
BIO-3	Erwin Ave. and Snipes Blvd.	3/25/2009	23:09:00	36.9	47.9	32.1	34.2	35.8	39.1
BIO-4	S. Lexington Dr. and Oak Avenue Parkway	3/26/2009	15:57:00	51.0	68.4	45.0	47.2	50.4	53.2

Site ID	Location	Start Date	Start Time (10 min. Meas.)	L_{eq} (dBA)	L_{max} (dBA)	L_{min} (dBA)	L90 (dBA)	L50 (dBA)	L10 (dBA)
BIO-4	S. Lexington Dr. and Oak Avenue Parkway	3/26/2009	20:58:00	49.6	61.0	44.0	46.4	48.5	51.3
BIO-4	S. Lexington Dr. and Oak Avenue Parkway	3/26/2009	23:48:00	43.1	63.1	34.4	36.4	40.1	45.1
BIO-5	Willow Bend Rd. and Grey Fox Ct.	3/26/2009	14:21:00	49.8	60.5	43.2	45.8	49.0	52.0
BIO-5	Willow Bend Rd. and Grey Fox Ct.	3/26/2009	20:13:00	46.4	56.8	37.7	40.6	43.8	50.1
BIO-5	Willow Bend Rd. and Grey Fox Ct.	3/26/2009	23:07:00	37.1	51.1	27.5	30.5	34.6	40.2
BIO-6	Haddington Dr. and E. Natoma St.	3/26/2009	13:45:00	51.9	63.5	45.3	48.1	50.9	54.1
BIO-6	Haddington Dr. and E. Natoma St.	3/26/2009	19:53:00	52.0	64.7	40.9	45.5	49.4	55.8
BIO-6	Haddington Dr. and E. Natoma St.	3/26/2009	22:49:00	47.9	66.5	31.4	36.0	42.3	48.5
BIO-7	Sturbridge Dr. and Stonemill Dr.	3/26/2009	14:54:00	42.7	59.5	34.5	36.8	40.6	45.5
BIO-7	Sturbridge Dr. and Stonemill Dr.	3/26/2009	20:34:00	38.5	52.6	32.6	35.5	37.6	40.5
BIO-7	Sturbridge Dr. and Stonemill Dr.	3/26/2009	23:27:00	31.4	43.8	26.7	29.1	30.6	32.8
BIO-8	Wellington Way and Grizzly Way	3/24/2009	15:53:00	58.0	67.5	42.9	48.3	56.5	61.7

Site ID	Location	Start Date	Start Time (10 min. Meas.)	L_{eq} (dBA)	L_{max} (dBA)	L_{min} (dBA)	L90 (dBA)	L50 (dBA)	L10 (dBA)
BIO-8	Wellington Way and Grizzly Way	3/24/2009	19:38:00	59.9	71.4	44.5	49.9	56.7	63.7
BIO-8	Wellington Way and Grizzly Way	3/24/2009	22:18:00	51.2	68.7	39.5	42.9	45.0	53.6

Alternative 2 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Site Prep / Haul Rd Prep						
Large Dozer	1	570	10	80%	81.0	115.6
Small Dozer	1	185	10	80%	81.0	115.6
Large Motor Grader	1	275	10	80%	84.0	118.6
Large Roller	1	250	10	80%	79.0	113.6
80 Ton Crane	1	200	10	80%	80.0	114.6
4 Mgal Water Truck	1	350	10	80%	75.0	109.6
Generator	2	200	10	65%	82.1	116.7
Welding Machines	4	30	10	50%	77.0	111.6
Outboard powered workskiffs	2	40	10	40%	78.2	112.8
Rock Import Trucks	10	350	10	90%	85.5	120.1
Small Tug	1	250	10	80%	86.2	120.7
Super 30 carrylift	1	350	10	70%	83.5	118.0
Construct Transload Facility						
Large Dozer	1	570	10	80%	81.0	115.6
Small Dozer	1	185	10	80%	81.0	115.6
Large Motor Grader	1	275	10	80%	84.0	118.6
Large Roller	1	250	10	30%	74.8	109.4
225T Crane	1	400	10	80%	80.0	114.6
80 Ton Crane	1	200	10	80%	80.0	114.6
4 Mgal Water Truck	1	350	10	80%	75.0	109.6
8 Mgal Water WAGON	1	450	10	80%	75.0	109.6

Alternative 2 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Off HWY 50 TN Trucks	2	650	10	80%	78.0	112.6
Rock Import Trucks	3	350	10	70%	79.2	113.8
Large Excavator	1	550	10	90%	80.5	115.1
Rub Tire Backhoe	1	125	10	70%	76.5	111.0
Loader 980 size	1	350	10	70%	77.5	112.0
Super 30 carrylift	1	350	10	70%	83.5	118.0
Loader 966 size	1	300	10	80%	78.0	112.6
Concrete Secant Pile Wall						
Large Dozer	1	570	10	80%	81.0	115.6
1200 CFM Compressor	4	575	10	15%	75.8	110.4
Large Roller	1	250	10	10%	70.0	104.6
Drill Rig	2	670	10	30%	81.8	116.4
100 Ton Crane	2	643	10	30%	78.8	113.4
8 Mgal Water WAGON	1	450	10	20%	69.0	103.6
20 CY Dump Trucks	4	350	10	30%	76.8	111.4
Rub Tire Backhoe	2	125	10	80%	80.0	114.6
Loader 360 Wheel Loader	2	100	10	80%	81.0	115.6
Loader 966 size	2	300	10	80%	81.0	115.6
Cutoff Wall Concrete Placement						
Cement Mixer	1	25	10	80%	77.0	111.6
Large Excavator	1	700	10	90%	80.5	115.1

Alternative 2 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Common Excavation to Waste						
Large Dozer-Ripper	2	570	10	90%	84.6	119.1
Large Excavator	1	428	10	90%	80.5	115.1
Off HWY 50 TN Trucks	7	650	10	80%	83.5	118.1
8 MG Water Pull	1	450	10	90%	75.5	110.1
Large Motor Grader	1	400	10	90%	84.5	119.1
Dozer	1	185	10	90%	81.5	116.1
Roller	1	250	10	50%	77.0	111.6
Rock Excavation Dry						
Rock Drills	4	250	12	100%	87.0	121.6
Large Excavator	1	428	12	90%	80.5	115.1
Off HWY 50 TN Trucks	6	650	12	80%	82.8	117.4
8 MG Water Pull	1	450	12	90%	75.5	110.1
Large Dozer-Ripper	1	550	12	90%	81.5	116.1
Large Motor Grader	1	400	12	40%	81.0	115.6
8 MG Water Pull	1	450	12	90%	75.5	110.1
Dozer	1	185	12	90%	81.5	116.1
Powder Truck	1	350	12	90%	75.5	110.1
Mobilization for Approach Walls (Road, Crane Pads)						
Cat D-8 Dozer -Ripper	1	305	10	80%	81.0	115.6
Cat 980 Loader	1	318	10	80%	78.0	112.6
Cat 730 Articulated trucks	3	317	10	80%	79.8	114.4

Alternative 2 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Highway 10-wheeler dump truck	1	330	10	80%	75.0	109.6
Graders 140H	1	165	10	80%	84.0	118.6
Water Truck 4000gal	1	330	10	80%	75.0	109.6
Highway tractor - trailer	1	330	10	60%	73.8	108.4
Electric - Line Man Truck	1	200	10	70%	74.5	109.0
Mech trucks	2	200	10	70%	77.5	112.0
Fuel trucks	2	250	10	70%	77.5	112.0
Pipe Fitters Truck	1	200	10	70%	74.5	109.0
Flatbed trucks	2	200	10	60%	75.8	110.4
Pickup's standard F-150 (gas)	5	380	10	50%	79.0	113.6
Pickup's Ford 150 4X4 (gas)	2	411	10	50%	75.0	109.6
Intake Approach Walls & Slab						
Manitowoc 555 - 150 ton Crawler	1	340	9	70%	79.5	114.0
50 ton Hydraulic Crane	1	174	9	70%	79.5	114.0
Concrete Boom Pump	1	330	10	70%	79.5	114.0
Highway tractor - trailer	1	330	9	70%	74.5	109.0
Pickup's Ford 150 4X4 (gas)	1	411	9	50%	72.0	106.6
Set up/Operate Bubble Curtain/Silt Curtain*						
Tendors	2	200	10	70%	87.6	122.2
Dozer	1	250	10	80%	81.0	115.6

Alternative 2 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Mid size Excavator	1	200	10	80%	80.0	114.6
Small Tug	1	250	10	80%	86.2	120.7
Large Tug	1	400	10	60%	86.9	121.5
1500 CFM Compressors	4	600	24	15%	75.8	110.4
80 TN crane	1	250	10	80%	80.0	114.6
Super 20 Carrylift	1	200	10	60%	82.8	117.4
Dredge Common to Rock*						
Large long reach Excavator/cutter	1	1100	20	90%	93.1	127.7
250 Ton Clam Derrick Barge	2	450	20	50%	81.0	115.6
Large Tug	2	500	20	50%	90.1	124.7
85 TN Rock Trucks	3	650	20	70%	79.2	113.8
Light plants	3	40	20	100%	83.9	118.5
Dozer	1	450	20	70%	80.5	115.0
Large Loader	1	500	20	10%	69.0	103.6
Barge Winches	1	400	20	40%	85.2	119.8
Drill and Shoot/Dredge Rock Wet*						
Rock Drills	3	350	20	80%	84.8	119.4
Large long reach Excavator/cutter	1	1100	20	80%	92.6	127.2
250 Ton Clam Derrick Barge	2	450	20	50%	81.0	115.6
Small Tug	1	250	20	40%	83.1	117.7

Alternative 2 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Large Tug	1	500	20	60%	87.9	122.5
50 TN Rock Trucks	5	600	20	75%	81.7	116.3
Light plants	4	40	20	60%	83.0	117.5
Large Dozer	1	450	20	50%	79.0	113.6
Large Loader	1	500	20	20%	72.0	106.6
Barge Winches	8	250	20	20%	89.2	123.7
Powder Truck	1	350	12	80%	75.0	109.6
Haul Road Prep, Spur Dike Stripping						
Large Dozer	1	570	10.43	80%	81.0	115.6
Large Motor Grader	1	275	10.43	80%	84.0	118.6
Large Excavator	1	532	10.43	60%	78.8	113.4
8 Mgal water truck	1	490	10.43	90%	75.5	110.1
40 TN Articulated Trucks	2	405	10.43	90%	78.6	113.1
80 Ton Crane	1	350	10.43	80%	80.0	114.6
Super 20 Carrylift	1	225	10.43	60%	82.8	117.4
Import Material from Quarry to D1/D2 MIAD						
On Hwy Transport Truck and Trailers	25	350	10.43	100%	90.0	124.6
Large Dozer	1	570	10.43	100%	82.0	116.6
Rehandle all imported material to Spur Dike from D1/D2 MIAD, Emb Core and Rock Fill						
Large Dozer-Ripper	1	570	10.43	90%	81.5	116.1
Large Excavator	1	532	10.43	90%	80.5	115.1

Alternative 2 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
40 TN articulated Trucks	6	405	10.43	95%	83.6	118.1
8 Mgal Water Truck	1	490	10.43	90%	75.5	110.1
Large Motor Grader	1	275	10.43	20%	78.0	112.6
Dozer	1	305	10.43	90%	81.5	116.1
Self Propelled Vibratory Roller	1	153	10.43	25%	74.0	108.6
Rehandle all imported material to Spur Dike from D1/D2 MIAD, Rip Rap Bedding and Rip Rap						
Large Excavator	1	532	10.43	80%	80.0	114.6
Large Dozer	1	570	10.43	50%	79.0	113.6
Large Front End Loader	1	490	10.43	100%	79.0	113.6
Foundation Clean up						
Large Tug	1	500	10	60%	87.9	122.5
Large long reach Excavator/cutter	1	1100	10	60%	91.3	125.9
1500 CFM Compressors	2	600	10	90%	80.6	115.1
Small Tug	1	250	10	80%	86.2	120.7
250 Ton Clam Derrick Barge	2	450	10	80%	83.0	117.6
Large Loader	1	500	10	40%	75.0	109.6
Barge Winches	4	250	10	40%	89.2	123.7
50 TN Rock Trucks	2	600	10	50%	76.0	110.6
Large Dozer	1	450	10	50%	79.0	113.6
Tendors	1	200	10	70%	84.6	119.2

Alternative 2 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Remove Transload Facility						
Large Dozer	1	570	10	80%	81.0	115.6
Small Dozer	1	185	10	80%	81.0	115.6
Large Motor Grader	1	275	10	80%	84.0	118.6
Large Roller	1	250	10	30%	74.8	109.4
225T Crane	1	400	10	80%	80.0	114.6
80 Ton Crane	1	200	10	80%	80.0	114.6
4 Mgal Water Truck	1	350	10	80%	75.0	109.6
8 Mgal Water WAGON	1	450	10	80%	75.0	109.6
Off HWY 50 TN Trucks	2	650	10	80%	78.0	112.6
Rock Import Trucks	3	350	10	70%	79.2	113.8
Large Excavator	1	550	10	90%	80.5	115.1
Rub Tire Backhoe	1	125	10	70%	76.5	111.0
Loader 980 size	1	350	10	70%	77.5	112.0
Super 30 carrylift	1	350	10	70%	83.5	118.0
Loader 966 size	1	300	10	80%	78.0	112.6
Site Restoration/Teardown						
Pick up Trucks	6	200	10	30%	77.6	112.1
Large Motor Grader	1	400	10	80%	84.0	118.6
Generator	2	200	10	65%	82.1	116.7
Outboard powered workskiffs	2	40	10	65%	80.3	114.9
Shop Trucks	2	250	10	40%	75.0	109.6

Alternative 2 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Large Tug	1	400	10	70%	87.6	122.2
Small Tug	1	250	10	70%	85.6	120.2
Dozer	1	185	10	60%	79.8	114.4
Medium Size Excavator	1	200	8	90%	80.5	115.1
Staging Area w/ Rock Crusher						
Rock Crusher	1	n/a	12	100%**	83.0	117.6
Batch Plant	1	n/a	12/24	100%**	83.0	117.6
Large Dozer	2	570	12	100%**	82.0	116.6
Belly dump truck	2	300	12	100%**	79.0	113.6
Staging Area w/out Rock Crusher						
Batch Plant	1	n/a	12/24	100%**	83.0	117.6
Large Dozer	2	570	12	100%**	82.0	116.6
Belly dump truck	2	300	12	100%**	79.0	113.6
Batch Plant Activities at Staging Area*						
Batch Plant	1	n/a	12/24	100%**	83.0	117.6

*potential nighttime activity
**assumed 100% duty cycle

Alternative 3 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Mobilization for Cofferdam (Haul Road)						
Large Dozer	1	570	10	80%	81.0	115.6
Small Dozer	1	185	10	80%	81.0	115.6
Large Motor Grader	1	275	10	80%	84.0	118.6
Large Roller	1	250	10	80%	79.0	113.6
80 Ton Crane	1	200	10	80%	80.0	114.6
4 Mgal Water Truck	1	350	10	80%	75.0	109.6
Generator	2	200	10	65%	82.1	116.7
Welding Machines	4	30	10	50%	77.0	111.6
Outboard powered workskiffs	2	40	10	40%	78.2	112.8
Rock Import Trucks	10	350	10	90%	85.5	120.1
Small Tug	1	250	10	80%	86.2	120.7
Super 30 carrylift	1	350	10	70%	79.5	114.0
Mid size Excavator	1	200	10	80%	84.0	118.6
Construct Transload Facility						
Large Dozer	1	570	10	80%	81.0	115.6
Small Dozer	1	185	10	80%	81.0	115.6
Large Motor Grader	1	275	10	80%	84.0	118.6
Large Roller	1	250	10	30%	74.8	109.4
225T Crane	1	400	10	80%	80.0	114.6

Alternative 3 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
80 Ton Crane	1	200	10	80%	80.0	114.6
4 Mgal Water Truck	1	350	10	80%	75.0	109.6
8 Mgal Water WAGON	1	450	10	80%	75.0	109.6
Off HWY 50 TN Trucks	2	650	10	80%	78.0	112.6
Rock Import Trucks	3	350	10	70%	79.2	113.8
Large Excavator	1	550	10	90%	80.5	115.1
Rub Tire Backhoe	1	125	10	70%	76.5	111.0
Loader 980 size	1	350	10	70%	77.5	112.0
Super 30 carrylift	1	350	10	70%	83.5	118.0
Loader 966 size	1	300	10	80%	78.0	112.6
Common Excavation Below Cofferdam						
Large Dozer-Ripper	2	570	10	90%	84.6	119.1
Large Excavator	1	428	10	90%	80.5	115.1
Off HWY 50 TN Trucks	7	650	10	80%	83.5	118.1
8 MG Water Pull	1	450	10	90%	75.5	110.1
Large Motor Grader	1	400	10	90%	84.5	119.1
Dozer	1	250	10	90%	81.5	116.1
Common Dredge Below Cofferdam*						
Large Long Reach Excavator/ Cutter	1	1100	20	90%	93.1	127.7
250 Ton Clam Derrick Barge	2	450	20	50%	89.7	124.3
Large Tug	2	500	20	50%	90.1	124.7
85 TN Rock Trucks	3	650	20	70%	79.2	113.8

Alternative 3 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Light Plants	3	40	20	100%	83.9	118.5
Dozer	1	450	20	70%	80.5	115.0
Large Loader	1	500	20	10%	69.0	103.6
Barge Winches	1	400	20	40%	85.2	119.8
Construction of Sheet Pile Cells						
4100 Manitowoc Crane	1	364	10	100%	81.0	115.6
Barge Winches	2	400	10	50%	89.2	123.7
Vibro Hammer	1	250	10	80%	100.0	134.6
Pile Hammer	1	250	10	20%	94.0	128.6
Generator	1	250	10	50%	78.0	112.6
250 CFM Compressor	1	150	10	50%	75.0	109.6
Welding Machine	1	30	10	20%	67.0	101.6
Pump	1	200	10	5%	68.0	102.6
Yard crane	1	350	10	20%	74.0	108.6
Outboard powered workskiffs	1	40	10	25%	73.1	107.7
Material Transport Tugboat	1	500	10	100%	90.1	124.7
Fill Cells						
20 CY bottom dump trucks	6	300	10	75%	82.5	117.1
Front end loader	1	200	10	75%	77.8	112.3
4100 Manitowoc Crane	1	364	10	100%	81.0	115.6
Barge Winches	2	800	10	50%	92.2	126.8
Vibro Hammer	1	250	10	80%	100.0	134.6

Alternative 3 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Pile Hammer	1	250	10	20%	94.0	128.6
Generator	1	250	10	50%	78.0	112.6
250 CFM Compressor	1	150	10	50%	75.0	109.6
Welding Machine	1	30	10	20%	67.0	101.6
Pump	1	200	10	5%	68.0	102.6
Fill Processing Plant	1	1100	10	90%	93.1	127.7
Mobilization for Approach Walls (Roads, Crane Pads)						
Cat D-8 Dozer -Ripper	1	305	10	80%	81.0	115.6
Cat 980 Loader	1	318	10	80%	78.0	112.6
Cat 730 Articulated trucks	3	317	10	80%	79.8	114.4
Highway 10-wheeler dump truck	1	330	10	80%	75.0	109.6
Graders 140H	1	165	10	80%	84.0	118.6
Water Truck 4000gal	1	330	10	80%	75.0	109.6
Highway tractor - trailer	1	330	10	60%	73.8	108.4
Electric - Line Man Truck	1	200	10	70%	74.5	109.0
Mech trucks	2	200	10	70%	77.5	112.0
Fuel trucks	2	250	10	70%	77.5	112.0
Pipe Fitters Truck	1	200	10	70%	74.5	109.0
Flatbed trucks	2	200	10	60%	74.8	109.4
Pickup's standard F-150 (gas)	5	380	10	50%	79.0	113.6
Pickup's Ford 150 4X4 (gas)	2	411	10	50%	75.0	109.6

Alternative 3 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Intake Approach Walls & Slab						
Manitowoc 555 - 150 ton Crawler	1	340	9	70%	79.5	114.0
50 ton Hydraulic Crane	1	174	9	70%	79.5	114.0
Concrete Boom Pump	1	330	10	70%	79.5	114.0
Highway tractor - trailer	1	330	9	70%	74.5	109.0
Pickup's Ford 150 4X4 (gas)	1	411	9	50%	72.0	106.6
Remove cell rubble fill						
3900 Manitowoc Crane	1	300	10	80%	80.0	114.6
20 CY bottom dump trucks	6	300	10	100%	83.8	118.4
Dozer	2	180	10	80%	84.0	118.6
Remove sheets						
4100 Manitowoc Crane	1	364	10	100%	81.0	115.6
Barge Winches	2	400	10	50%	89.2	123.7
Vibro Hammer	1	250	10	80%	86.2	120.7
Pile Hammer	1	250	10	20%	80.1	114.7
Generator	1	250	10	50%	78.0	112.6
250 CFM Compressor	1	150	10	50%	75.0	109.6
Welding Machine	1	30	10	20%	67.0	101.6
Pump	1	200	10	5%	68.0	102.6
Material Transport Tugboat	1	500	10	100%	90.1	124.7
Yard crane	1	350	10	100%	81.0	115.6

Alternative 3 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Common Excavation						
Large Dozer-Ripper	2	570	10	90%	84.6	119.1
Large Excavator	1	428	10	90%	80.5	115.1
Off HWY 50 TN Trucks	7	650	10	80%	83.5	118.1
8 MG Water Pull	1	450	10	90%	75.5	110.1
Large Motor Grader	1	400	10	90%	84.5	119.1
Dozer	1	250	10	90%	81.5	116.1
Rock Excavation Dry						
Rock Drills	4	250	12	100%	87.0	121.6
Large Excavator	1	428	12	90%	80.5	115.1
Off HWY 50 TN Trucks	5	650	12	80%	82.0	116.6
8 MG Water Pull	1	450	12	90%	75.5	110.1
Large Dozer-Ripper	1	550	12	90%	81.5	116.1
Large Motor Grader	1	400	12	40%	81.0	115.6
8 MG Water Pull	1	450	12	90%	75.5	110.1
Dozer	1	185	12	90%	81.5	116.1
Powder Truck	1	350	12	90%	75.5	110.1
Dewater Behind Cofferdam*						
Pump	1	2200	24	85%	95.9	130.4
Set up/operate Bubble Curtain/Silt Curtain						
Tendors	2	200	10	70%	87.6	122.2
Dozer	1	250	10	80%	81.0	115.6

Alternative 3 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Mid size Excavator	1	200	10	80%	80.0	114.6
Small Tug	1	250	10	80%	86.2	120.7
Large Tug	1	400	10	60%	86.9	121.5
1500 CFM Compressors	4	600	24	15%	75.8	110.4
80 TN crane	1	250	10	80%	80.0	114.6
Super 20 Carrylift	1	200	10	60%	78.8	113.4
Dredge Common to Rock*						
Large long reach Excavator/cutter	1	1100	20	90%	93.1	127.7
250 Ton Clam Derrick Barge	2	450	20	50%	81.0	115.6
Large Tug	2	500	20	50%	90.1	124.7
85 TN Rock Trucks	3	650	20	70%	79.2	113.8
Light plants	3	40	20	100%	83.9	118.5
Dozer	1	450	20	70%	80.5	115.0
Large Loader	1	500	20	10%	69.0	103.6
Barge Winches	1	400	20	40%	85.2	119.8
Drill and Shoot/Dredge Rock Wet*						
Rock Drills	3	350	20	80%	84.8	119.4
Large long reach Excavator/cutter	1	1100	20	80%	92.6	127.2
250 Ton Crane/Derrick	2	450	20	50%	81.0	115.6
Small Tug	1	250	20	40%	83.1	117.7
Large Tug	1	500	20	60%	87.9	122.5

Alternative 3 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
50 TN Rock Trucks	3	600	20	60%	78.6	113.1
Light plants	4	40	20	60%	83.0	117.5
Large Dozer	1	450	20	50%	79.0	113.6
Large Loader	1	500	20	20%	72.0	106.6
Barge Winches	8	250	20	20%	89.2	123.7
Powder Truck	1	350	12	80%	75.0	109.6
Haul Road Prep, Spur Dike Stripping						
Large Dozer	1	570	10.43	80%	81.0	115.6
Large Motor Grader	1	275	10.43	80%	84.0	118.6
Large Excavator	1	532	10.43	60%	78.8	113.4
8 Mgal water truck	1	490	10.43	90%	75.5	110.1
40 TN Articulated Trucks	2	405	10.43	90%	78.6	113.1
80 Ton Crane	1	350	10.43	80%	80.0	114.6
Super 20 Carrylift	1	225	10.43	60%	82.8	117.4
Import Material from Quarry to D1/D2 MIAD						
On Hwy Transport Truck and Trailers	25	350	10.43	100%	90.0	124.6
Large Dozer	1	570	10.43	100%	82.0	116.6
Rehandle all imported material to Spur Dike from D1/D2 MIAD, Emb Core and Rock Fill						
Large Dozer-Ripper	1	570	10.43	90%	81.5	116.1
Large Excavator	1	532	10.43	90%	80.5	115.1
40 TN articulated Trucks	6	405	10.43	95%	83.6	118.1
8 Mgal Water Truck	1	490	10.43	90%	75.5	110.1

Alternative 3 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Large Motor Grader	1	275	10.43	20%	78.0	112.6
Dozer	1	305	10.43	90%	81.5	116.1
Self Propelled Vibratory Roller	1	153	10.43	25%	79.0	113.6
Rehandle all imported material to Spur Dike from D1/D2 MIAD, Rip Rap Bedding and Rip Rap						
Large Excavator	1	532	10.43	80%	80.0	114.6
Large Dozer	1	570	10.43	50%	79.0	113.6
Large Front End Loader	1	490	10.43	100%	79.0	113.6
Foundation Clean Up						
Large Tug	1	500	10	60%	87.9	122.5
Large long reach Excavator/cutter	1	1100	10	60%	91.3	125.9
1500 CFM Compressors	2	600	10	90%	80.6	115.1
Small Tug	1	250	10	80%	86.2	120.7
250 Ton Clam Derrick Barge	2	450	10	80%	83.0	117.6
Large Loader	1	500	10	40%	75.0	109.6
Barge Winches	4	250	10	40%	89.2	123.7
50 TN Rock Trucks	2	600	10	50%	76.0	110.6
Large Dozer	1	450	10	50%	79.0	113.6
Tendors	1	200	10	70%	84.6	119.2
Remove Transload Facility						
Large Dozer	1	570	10	80%	81.0	115.6
Small Dozer	1	185	10	80%	81.0	115.6

Alternative 3 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
Large Motor Grader	1	275	10	80%	84.0	118.6
Large Roller	1	250	10	30%	74.8	109.4
225T Crane	1	400	10	80%	80.0	114.6
80 Ton Crane	1	200	10	80%	80.0	114.6
4 Mgal Water Truck	1	350	10	80%	75.0	109.6
8 Mgal Water WAGON	1	450	10	80%	75.0	109.6
Off HWY 50 TN Trucks	2	650	10	80%	78.0	112.6
Rock Import Trucks	3	350	10	70%	79.2	113.8
Large Excavator	1	550	10	90%	80.5	115.1
Rub Tire Backhoe	1	125	10	70%	76.5	111.0
Loader 980 size	1	350	10	70%	77.5	112.0
Super 30 carrylift	1	350	10	70%	79.5	114.0
Loader 966 size	1	300	10	80%	78.0	112.6
Site Restoration/Teardown						
Pick up Trucks	6	200	10	30%	77.6	112.1
Large Motor Grader	1	400	10	80%	84.0	118.6
Generator	2	200	10	65%	82.1	116.7
Outboard powered workskiffs	2	40	10	65%	80.3	114.9
Shop Trucks	2	250	10	40%	75.0	109.6
Large Tug	1	400	10	70%	87.6	122.2
Small Tug	1	250	10	70%	85.6	120.2
dozer	1	185	10	60%	79.8	114.4

Alternative 3 Equipment Estimate Summary

Equipment	Quantity	Horsepower (HP)	Hours per Day	Duty Cycle	Total SPL of Equipment at 50 Feet (dBA L_{eq})	Total PWL of Equipment (dBA)
medium size excavator	1	200	8	90%	80.5	115.1
Staging Area w/ Rock Crusher						
Rock Crusher	1	n/a	12	100%**	83.0	117.6
Batch Plant	1	n/a	12/24	100%**	83.0	117.6
Large Dozer	2	570	12	100%**	82.0	116.6
Belly dump truck	2	300	12	100%**	79.0	113.6
Staging Area w/out Rock Crusher						
Batch Plant	1	n/a	12/24	100%**	83.0	117.6
Large Dozer	2	570	12	100%**	82.0	116.6
Belly dump truck	2	300	12	100%**	79.0	113.6
Batch Plant Activities at Staging Area*						
Batch Plant	1	n/a	12/24	100%**	83.0	117.6

*potential nighttime activity
**assumed 100% duty cycle

Appendix G –

Traffic Analysis

Traffic Analysis Report
Prison Staging Area and Folsom Lake Crossing Road, Folsom, CA

Prepared by

CH2MHILL

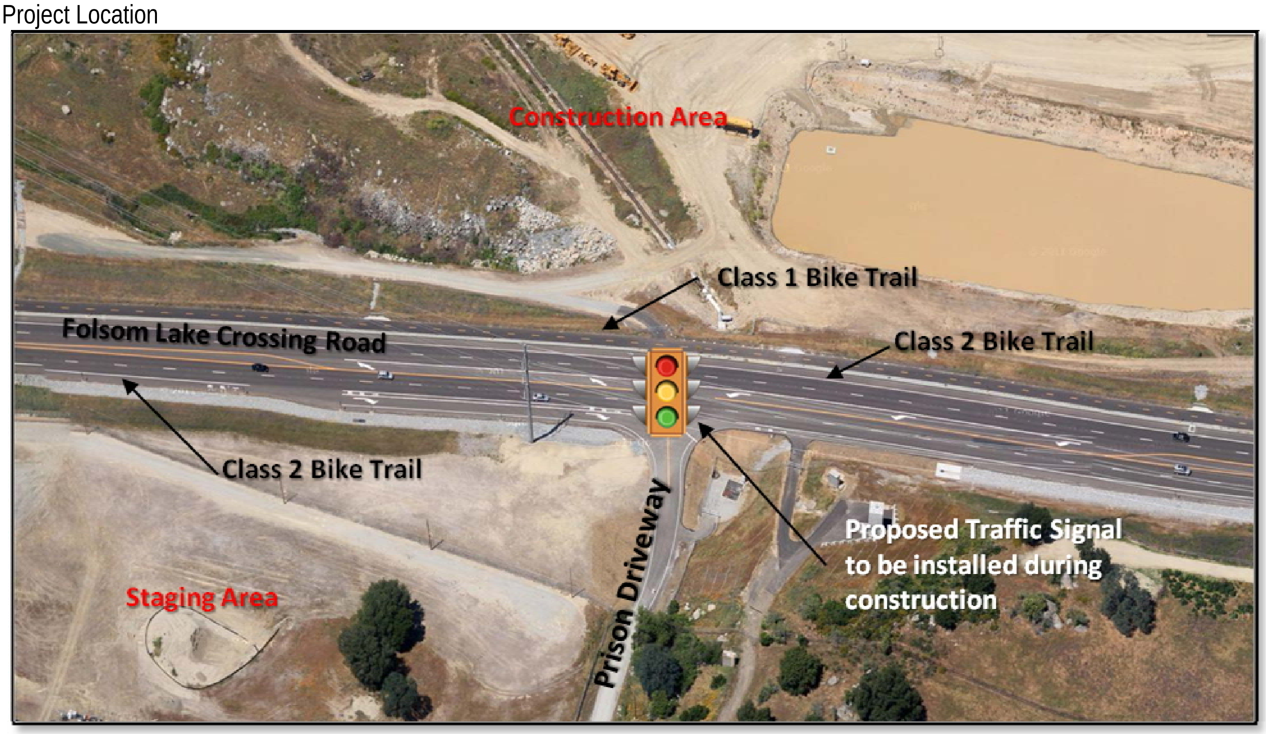
April 2012

Table of Contents

1. Introduction

Approximately 10 acres of land is being leased from the State of California for use as a staging area for the contractor who will be constructing the upstream and downstream work for the Folsom Joint Federal Project (JFP) Auxiliary Spillway Control Structure in Folsom, California. The staging area is located south of Folsom Lake Crossing Road, west of the Folsom Prison Driveway (approximately 2,500 feet east of the new Folsom Bridge). Construction traffic will travel through this intersection to access the staging area to the south and the construction area to the north. Construction traffic is anticipated to affect the daily and peak hour traffic on Folsom Lake Crossing Road. In addition, slow moving tucks leaving and entering the staging/construction areas through the intersection could present a hazard to higher speed traffic on Folsom Lake Crossing Road. For these reasons, the City of Folsom has determined that a temporary signalized intersection is required at this location. As part of the signalization of the intersection during construction, striping and roadway improvements will be made to provide turning movements into and out of Prison Driveway and the north side of the intersection (the construction site). On the north and south side of the intersection, there is a Class 2 Bike Trail along the edges of pavement. On the north side of the intersection, there is also a Class 1 Bike Trail approximately 4 feet north of the Class 2 trail. Figure 1 is an aerial image of the project location.

FIGURE 1
Project Location



The purpose of this traffic report is to analyze and document existing and proposed operations of the intersection at the Folsom Lake Crossing Road and the Prison Driveway. The analysis will assess the operation of the existing three-way unsignalized intersection and the proposed operation of the four-way signalized intersection. This report will also document the project impacts to bicycle traffic at the intersection.

Analysis Methodology

Intersection operations were assessed using the Synchro software package, which is consistent with the Highway Capacity Manual (HCM) methodologies. The existing three-way intersection was analyzed using the HCM methodology for stop-controlled intersections (one-way stop). The proposed four-way signalized intersection during construction was analyzed using the HCM methodology for signalized intersections.

The HCM delay is used to determine Level of Service (LOS), ranging from LOS A to LOS F using the delay ranges shown in Table 1.

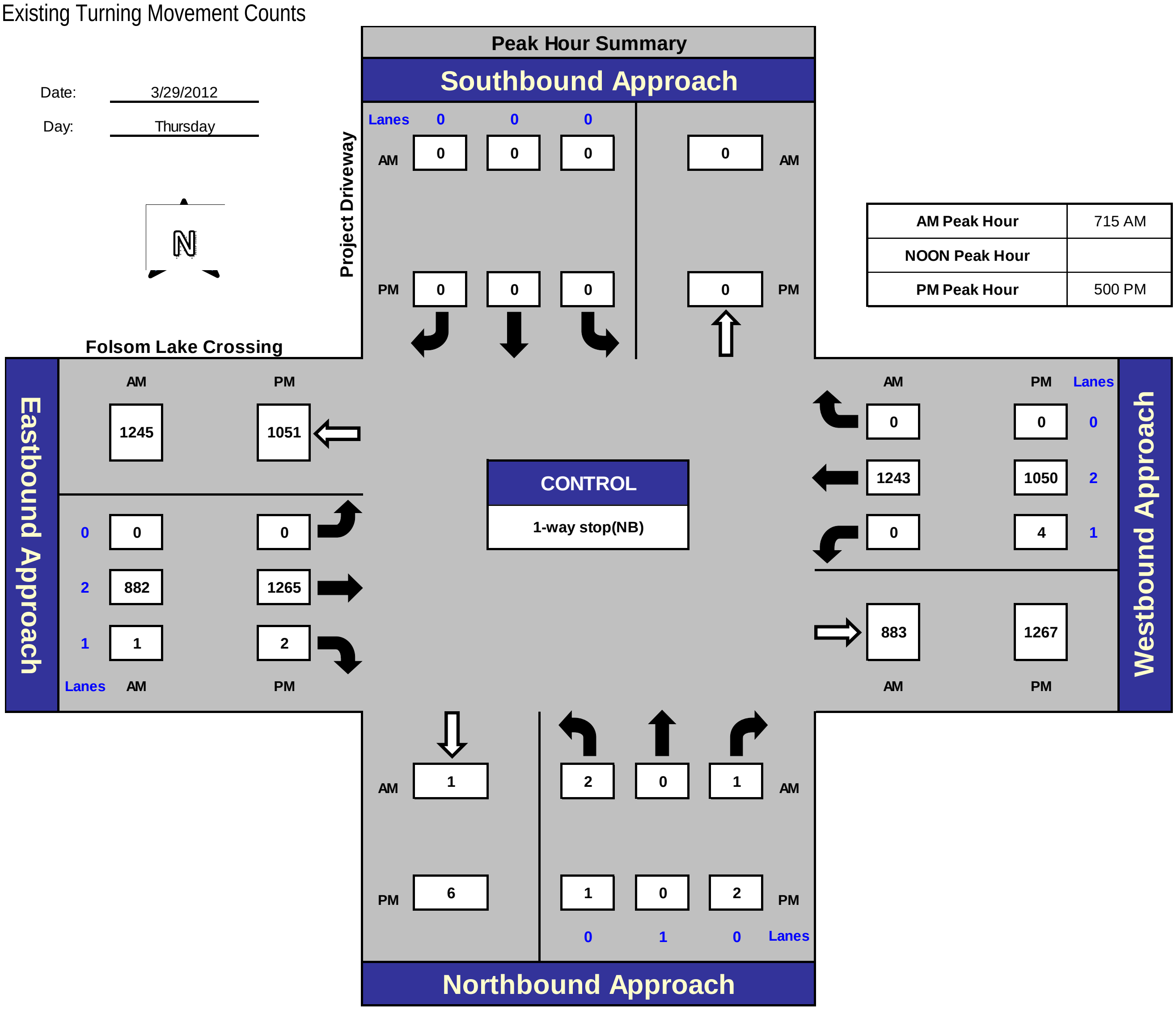
TABLE 1
HCM-Based Level of Service and Delay Ranges

Average Delay (seconds / vehicle)		LOS
Signalized Intersections	Unsignalized intersections	
< 10.0	< 10.0	A
> 10.0 to < 20.0	> 10.0 to < 15.0	B
> 20.0 to < 35.0	> 15.0 to < 25.0	C
> 35.0 to < 55.0	> 25.0 to < 35.0	D
> 55.0 to < 80.0	> 35.0 to < 50.0	E
> 80.0	> 50.0	F

2. Existing Conditions

Peak-hour traffic volume data for the study intersection was collected to quantify the existing traffic conditions. Morning (7 to 9 AM) and afternoon (4 to 6 PM) peak period turning movement counts were conducted at the study intersections on March 29th, 2012. The peak hour turning movement volumes are shown in Figure 2.

FIGURE 2
Existing Turning Movement Counts



The results of the existing conditions analysis are summarized in Table 2. Intersection analysis worksheets are provided in Attachment A. The intersection of Folsom Lake Crossing Road and Prison Driveway currently operates at LOS C in both the AM and PM peak hours.

TABLE 2
Existing (2012) Peak Hour Traffic Conditions

Intersection	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	**LOS**	**Delay (sec/veh)**	**LOS**
Folsom Lake Crossing Road and Prison Driveway*	17.8	C	19.7	C

Note: Peak hour analysis assumed two percent trucks.

sec/veh – seconds per vehicle

* Delay reported for worst stop-controlled approach on Prison Driveway (northbound)

3. Construction Traffic

Construction traffic to and from the staging area located on the south side of the Folsom Lake Crossing Road/Prison Driveway intersection will use the south leg of the intersection. Construction traffic to and from the construction area located north of the intersection will access the site via the north leg of the intersection. Intersection modifications are required to accommodate construction traffic turning in and out of both the north and south legs of the intersection. The existing unsignalized three-way intersection to will be revised to temporarily signalize the modified four-way intersection. The bicycle trails on both sides of the street will also be controlled through the proposed traffic signal. Figure 3 illustrates the proposed striping plan that will be implemented as part of the signal installation. Once construction is complete, the temporary traffic signal will be removed and the intersection will return to the existing stop-controlled configuration.

The estimated peak hour construction traffic expected to use the intersection is shown in Figure 4 and 5. Figure 4 presents the passenger cars and Figure 5 shows the estimated truck traffic during construction. A detailed estimate of construction traffic by movement throughout the day (5 AM to 7 PM) is provided in Attachment B.

FIGURE 3
Proposed Striping Layout

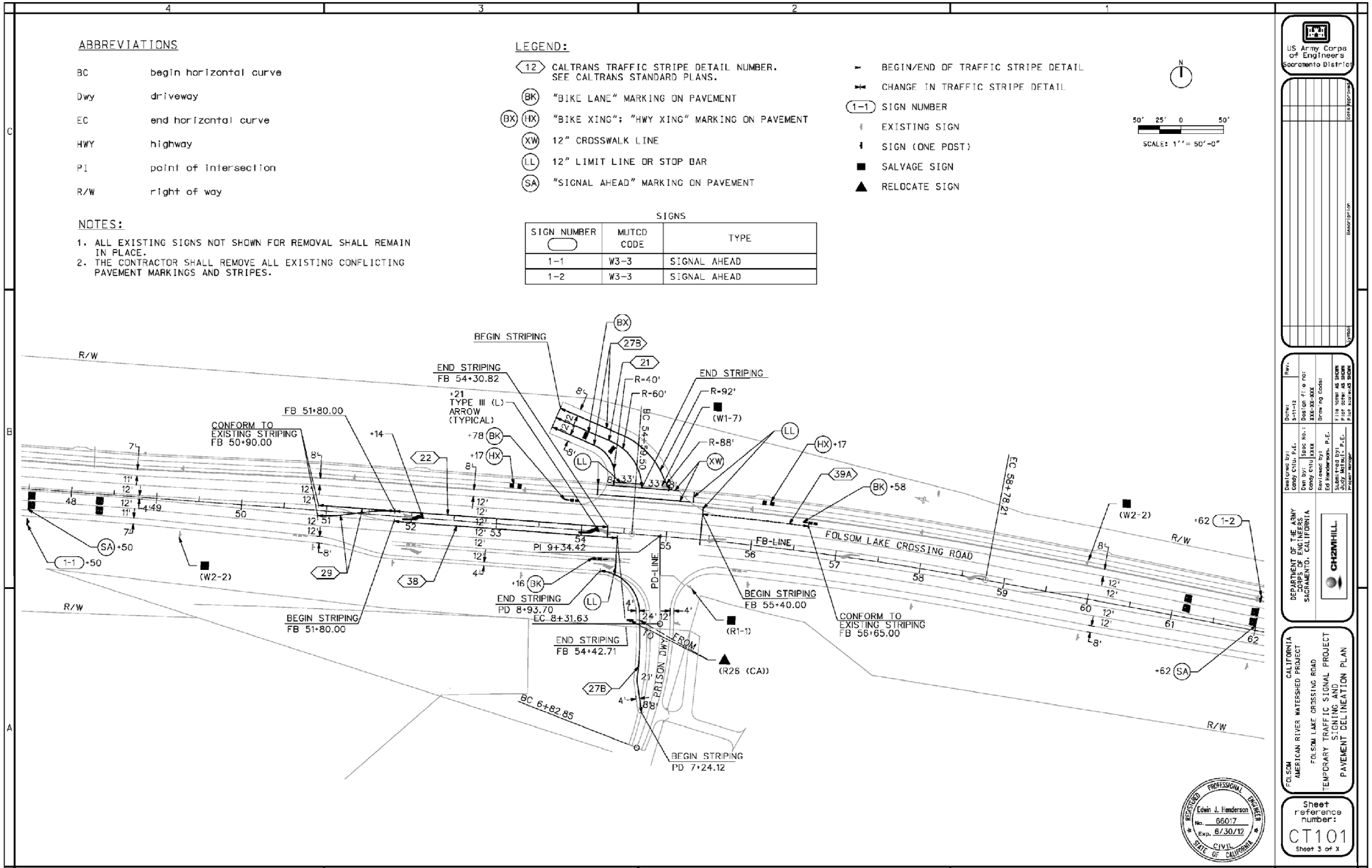


FIGURE 4
Estimated Construction Traffic (Passenger Cars only)

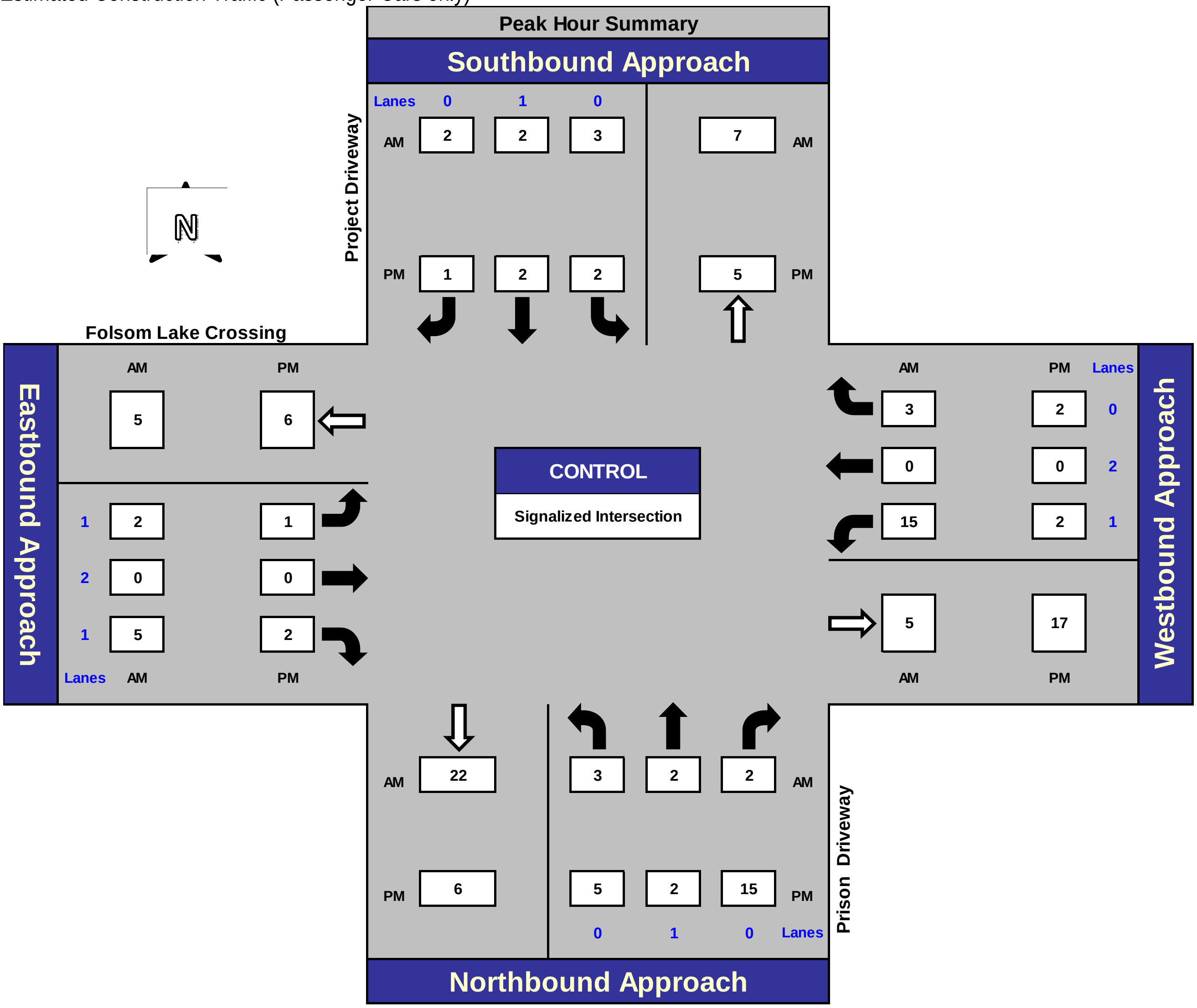
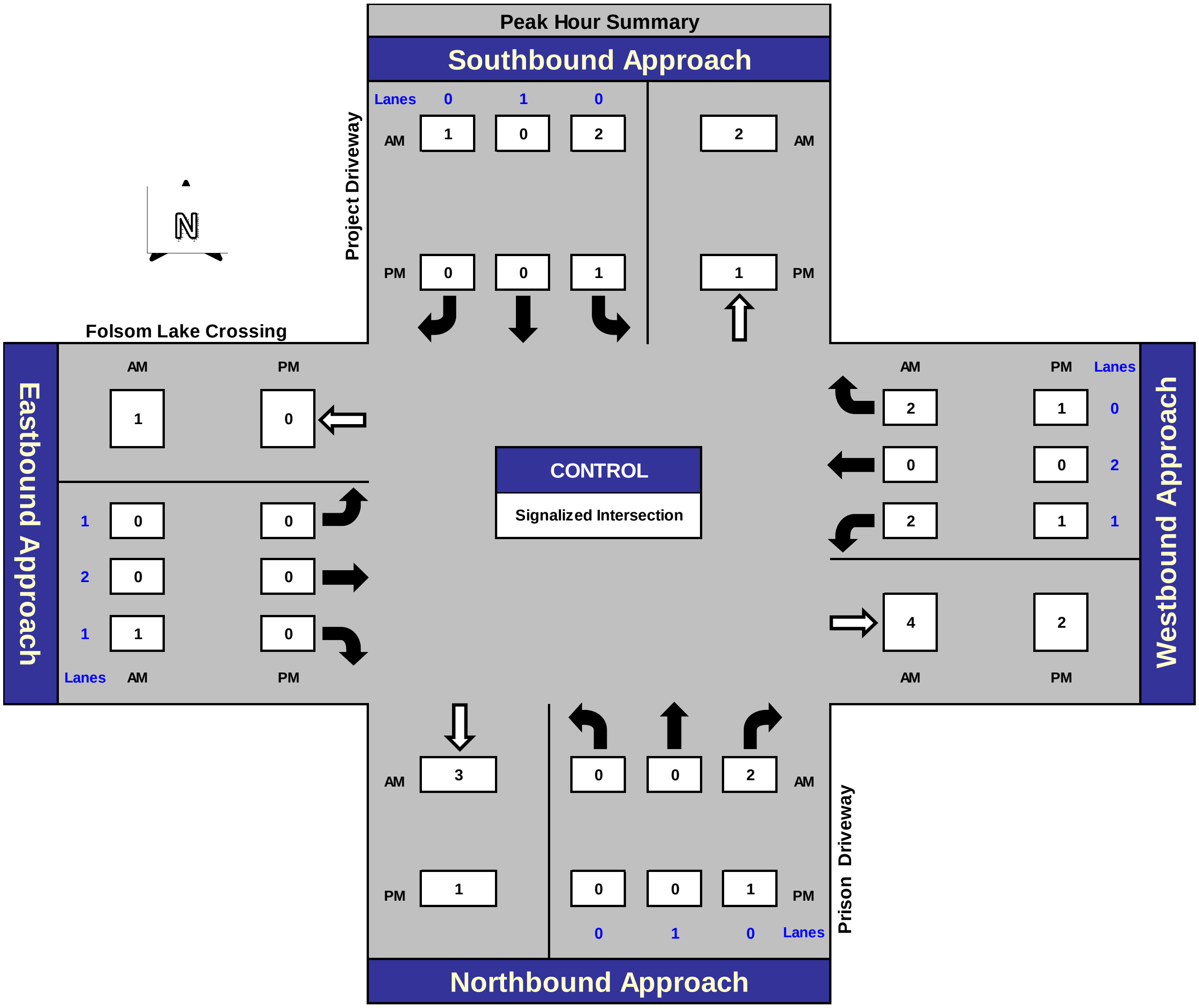


FIGURE 5
Estimated Construction Traffic (Trucks only)

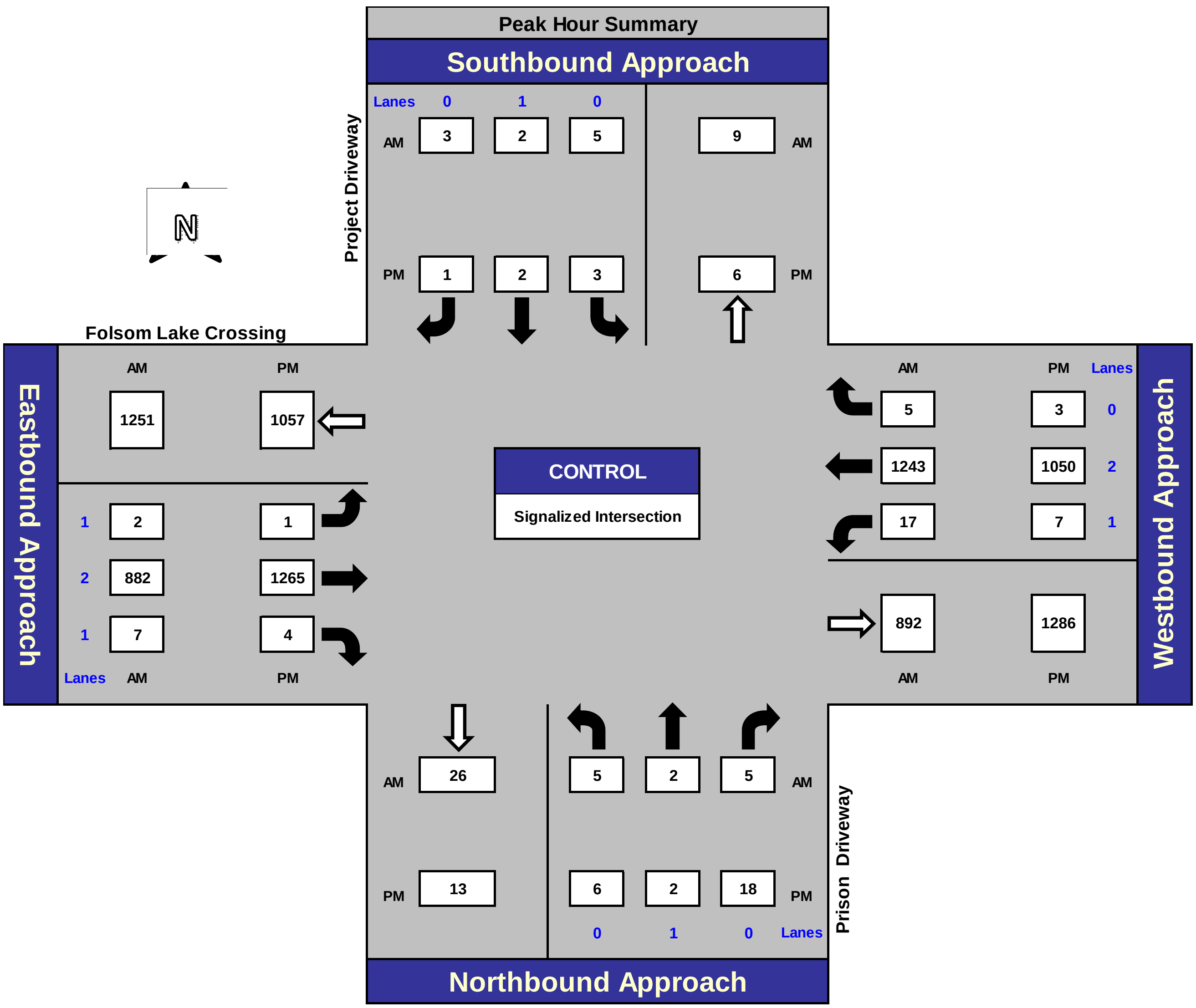


The City of Folsom has specified haul routes that will provide ingress/egress to the project site from the east. Therefore, the westbound left turn and northbound right turn movements will experience higher volumes than the other movements in the peak hours (although still relatively low). The percentage of trucks associated with the construction traffic is 12% in the AM peak hour and 8% in the PM peak hour.

4. Existing plus Construction Traffic Conditions

Peak hour traffic operations during construction at the intersection of Folsom Lake Crossing Road and Prison Driveway are analyzed in this chapter. For the existing plus construction traffic scenario, traffic volumes were developed by adding the estimated peak hour construction traffic volumes to existing condition peak hour volumes. The peak hour volumes of the existing plus construction traffic conditions are presented in Figure 6.

FIGURE 6
Existing plus Construction Traffic (Cars and Trucks combined)



The study intersection was analyzed as a signalized intersection and the following assumptions were also used in the Synchro analysis:

- Saturation flow rate = 1,900 vehicles/hour/lane
- Control Type = Actuated-Uncoordinated
- Cycle length = 70 seconds
- Yellow time = 3.0 seconds
- All-red time = 1.0 second

The results of the existing conditions and the existing plus construction traffic conditions are summarized in Table 3. The proposed signalized intersection will operate at LOS B during both peak hours with the addition of construction traffic and the installation of the temporary traffic signal. The control delay is projected to decrease during construction conditions due to the efficiency of the traffic signal operation.

The intersection analysis worksheets are provided in Attachment C.

TABLE 3
Existing with Construction Traffic Peak Hour Traffic Conditions

	Existing Conditions				**Existing Conditions with Construction Traffic**			
	AM Peak Hour		**PM Peak Hour**		**AM Peak Hour**		**PM Peak Hour**	
Intersection	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**	**Delay (sec/veh)**	**LOS**
Folsom Lake Crossing Road and Prison Driveway	17.8*	C	19.7*	C	19.0	B	18.2	B

Note: Peak hour analysis assumed two percent trucks for existing conditions, and two percent plus the estimated truck traffic added during construction.

sec/veh – seconds per vehicle

* Delay reported for worst stop-controlled approach on Prison Driveway (northbound)

Pedestrian and Bike Facilities

Existing pedestrian and bike volumes were collected on March 29th, 2012 and are provided in Attachment D. The existing counts show zero pedestrian volume in the AM and PM peak hours. Bicycle traffic was observed in both peak hours as noted below:

- AM peak hour: five bikes travelling westbound
- PM peak hour: 22 bikes travelling eastbound, 7 bikes travelling westbound

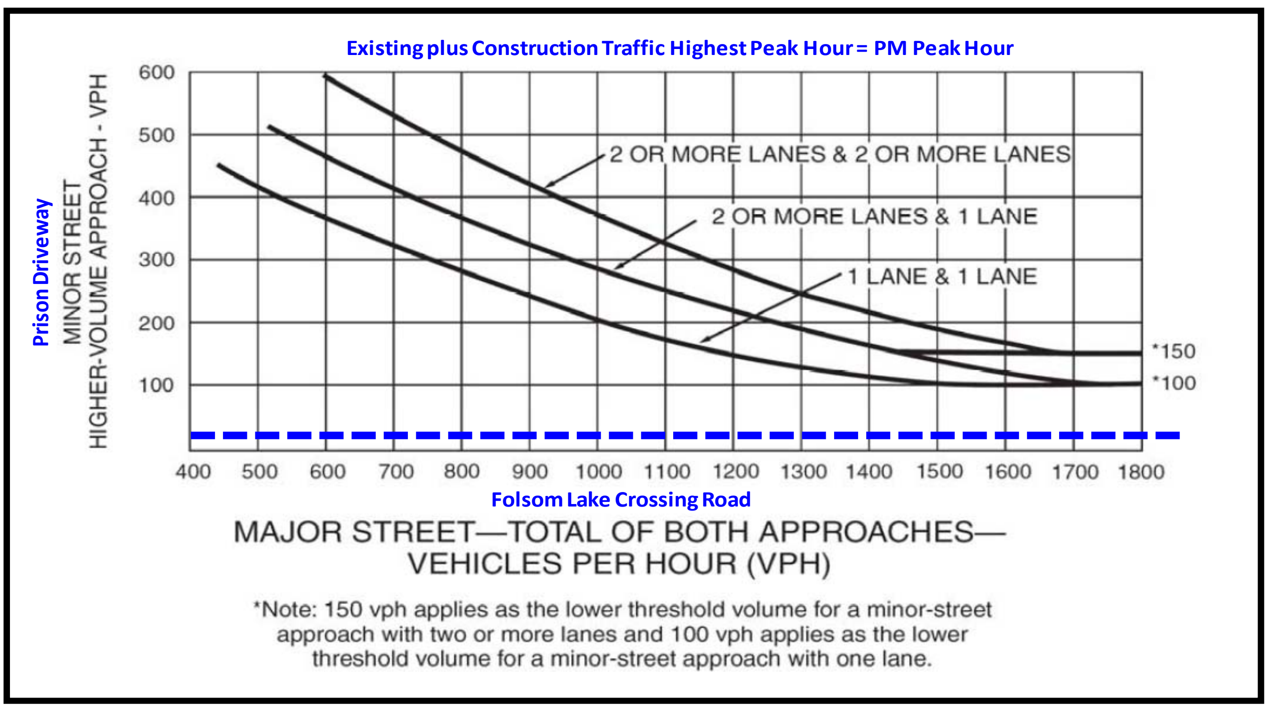
The proposed signal will be designed with pedestrian/bicycle phasing (push-button actuated) to accommodate the bike and pedestrian activity safely through the intersection.

Traffic Signal Warrant Analysis

A peak-hour traffic signal warrant analysis was performed for the unsignalized intersection of Folsom Lake Crossing Road and Prison Driveway using the existing plus construction traffic volumes. The PM peak-hour traffic volumes were used for the analysis because the PM peak-hour volumes are projected to be higher than the morning peak-hour volumes. The warrant analysis is based on the 2009 Manual of Uniform Traffic Control Devices (MUTCD) Warrant 3 (Peak Hour Warrant). The peak hour warrant is one of nine warrants used in the MUTCD. Since peak hour data was the only available data at the time of this study, this is the only warrant that can be studied at this time.

The total peak hour traffic volume on the major approaches is 2,535 vehicles/hour and the highest volume on the minor street approach is 26 vehicles/hour. Figures 7 illustrates that the proposed intersection does not meet the peak hour warrant. However, a traffic signal can be installed based on other warrants and/or factors such as safety. Because slow moving tucks leaving and entering the staging/construction areas through the intersection could present a hazard to higher speed traffic on Folsom Lake Crossing Road, the City of Folsom has determined that a signalized intersection is required at this location.

FIGURE 7
Peak Hour Signal Warrant – Folsom Lake Crossing Road and Prison Driveway



ATTACHMENT A
INTERSECTION ANALYSIS –EXISTING CONDITIONS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	882	1	0	1243	0	2	0	1	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	959	1	0	1351	0	2	0	1	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			None							
Median storage veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1351			960			1634	2310	479	1832	2311	676
vC1, stage 1 conf vol							959	959		1351	1351	
vC2, stage 2 conf vol							676	1351		480	960	
vCu, unblocked vol	1351			960			1634	2310	479	1832	2311	676
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			99	100	100	100	100	100
cM capacity (veh/h)	505			713			231	179	532	150	179	396

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	320	639	1	0	901	450	3	0
Volume Left	0	0	0	0	0	0	2	0
Volume Right	0	0	1	0	0	0	1	0
cSH	505	1700	1700	1700	1700	1700	285	1700
Volume to Capacity	0.00	0.38	0.00	0.00	0.53	0.26	0.01	0.00
Queue Length 95th (ft)	0	0	0	0	0	0	1	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	17.8	0.0
Lane LOS							C	A
Approach Delay (s)	0.0			0.0			17.8	0.0
Approach LOS							C	A

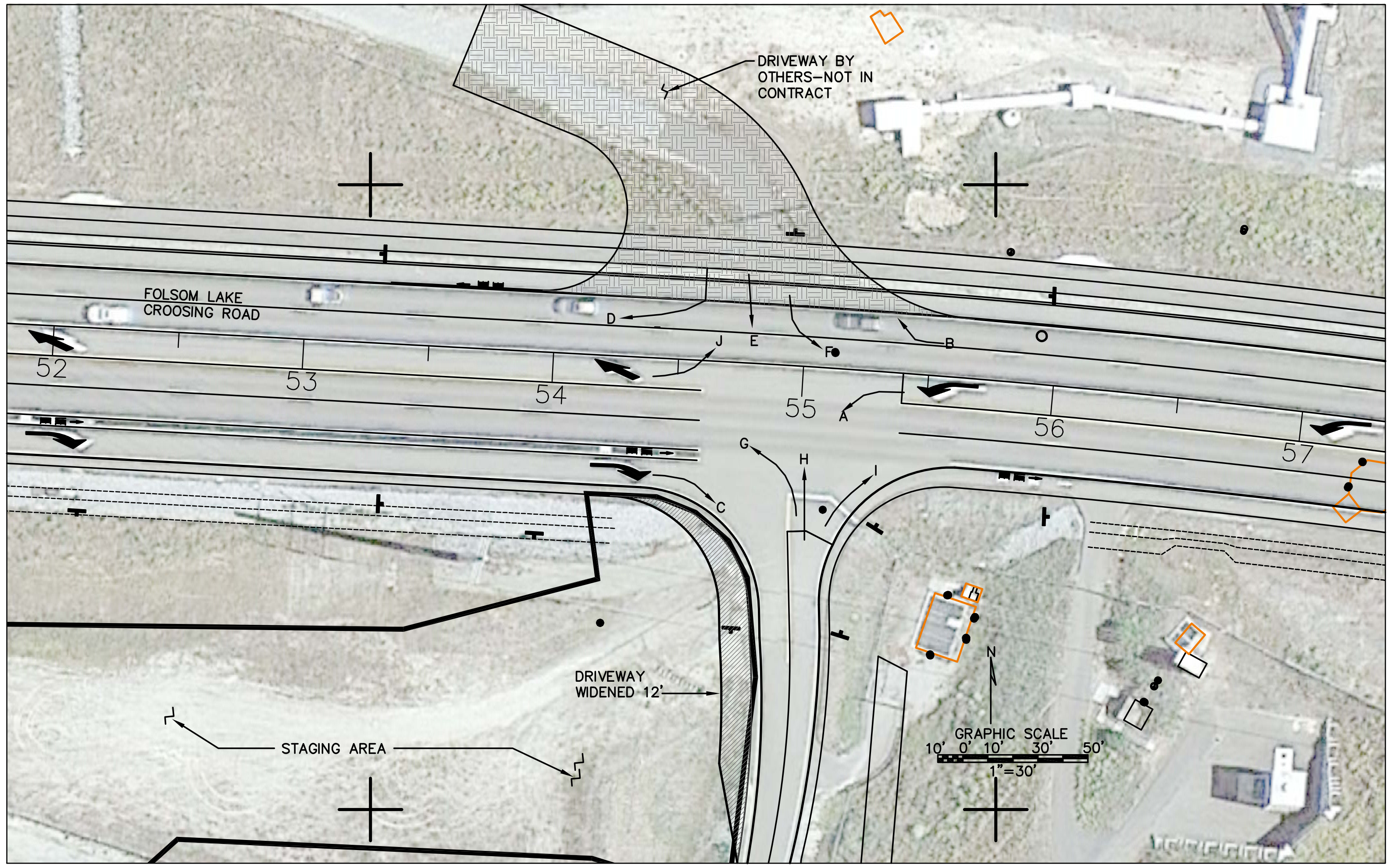
Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	44.4%	ICU Level of Service	A
Analysis Period (min)	15		

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (veh/h)	0	1265	2	4	1050	0	1	0	2	0	0	0
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	1375	2	4	1141	0	1	0	2	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		TWLTL			None							
Median storage veh)		2										
Upstream signal (ft)												
pX, platoon unblocked												
vC, conflicting volume	1141			1377			1954	2525	688	1840	2527	571
vC1, stage 1 conf vol							1375	1375		1150	1150	
vC2, stage 2 conf vol							579	1150		690	1377	
vCu, unblocked vol	1141			1377			1954	2525	688	1840	2527	571
tC, single (s)	4.1			4.1			7.5	6.5	6.9	7.5	6.5	6.9
tC, 2 stage (s)							6.5	5.5		6.5	5.5	
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			99			99	100	99	100	100	100
cM capacity (veh/h)	608			494			143	162	389	183	159	464

Direction, Lane #	EB 1	EB 2	EB 3	WB 1	WB 2	WB 3	NB 1	SB 1
Volume Total	688	688	2	4	761	380	3	0
Volume Left	0	0	0	4	0	0	1	0
Volume Right	0	0	2	0	0	0	2	0
cSH	1700	1700	1700	494	1700	1700	247	1700
Volume to Capacity	0.40	0.40	0.00	0.01	0.45	0.22	0.01	0.00
Queue Length 95th (ft)	0	0	0	1	0	0	1	0
Control Delay (s)	0.0	0.0	0.0	12.4	0.0	0.0	19.7	0.0
Lane LOS				B			C	A
Approach Delay (s)	0.0			0.0			19.7	0.0
Approach LOS							C	A

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	45.0%	ICU Level of Service	A
Analysis Period (min)	15		

ATTACHMENT B
CONSTRUCTION TRAFFIC BY MOVEMENT



ESTIMATED CONSTRUCTION TRAFFIC BY MOVEMENT A–J PER HOUR

TIME	A–TRUCK	A–CAR	B–TRUCK	B–CAR	C–TRUCK	C–CAR	D–TRUCK	D–CAR	E–TRUCK	E–CAR	F–TRUCK	F–CAR	G–TRUCK	G–CAR	H–TRUCK	H–CAR	I–TRUCK	I–CAR	J–TRUCK	J–CAR
0500–0600	2	5	3	3	1	5	1	1		1	3	3		1		1	2	2		1
0600–0700	2	20	3	3	1	10	2	1		2	3	3	1	2		2	2	2	1	1
0700–0800	2	15	2	3	1	5	1	2		2	2	3		3		2	2	2		2
0800–0900	2	10	2	2		4	1	2	1	3	2	2	1	3	1	3	2	2	1	2
0900–1000	5	6	1	2		4		2	1	3	1	2		4	1	3	5	6		2
1000–1100	4	6	1	2		4		4	1	3	1	2	1	4	1	3	4	6	1	4
1100–1200	4	6	1	1	1	4		9	1	3	1	1		9	1	3	4	5		9
1200–1300	4	6	1	2		8		5	1	3	1	2		8	1	3	4	5	1	5
1300–1400	4	10	1	4		9		2	1	3	1	4	1	4	1	3	4	5		2
1400–1500	2	6	1	2	1	2		2	1	3	1	2		2	1	3	2	5		2
1500–1600	1	2	1	1		2		2	1	3	1	1	1	8	1	3	1	10	1	2
1600–1700	1	2	1	1		2		1	1	2	1	1		8	1	2	1	25		1
1700–1800	1	2	1	2		2		1		2	1	2		5		2	1	15		1
1800–1900	1	2	1	2		2		1	1	1	1	2		2	1	1	1	8		1
TOTALS	35	98	20	30	5	63	5	35	10	34	20	30	5	63	10	34	35	98	5	35

PRELIMINARY
NOT FOR CONSTRUCTION

CENTRAL VALLEY PROJECT–CALIFORNIA
AMERICAN RIVER DIVISION – FOLSOM UNIT
DESIGNED U.S. ARMY CORPS OF ENGINEERS
RECEIVED BY
BUREAU OF RECLAMATION, GROUP MANAGER

US Army Corps of Engineers
Sacramento District

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
SACRAMENTO, CALIFORNIA

SACRAMENTO DISTRICT
IN-HOUSE DESIGN
1325 'J' STREET
SACRAMENTO, CA 95814–2922

Spec No.: 1866
Design file no: AM1–04–0642

AMERICAN RIVER WATERSHED CALIFORNIA
FOLSOM DAM AUXILIARY SPILLWAY
PRISON STAGING AREA

ESTIMATED CONSTRUCTION TRAFFIC

Sheet reference number:

USBR FILE NO. 485–D–XXXX

T:\JFP\Access Road\Staging area Intersection\CADD\Civil\ESTIMATED CONSTRUCTION TRAFFIC.dwg
LAST UPDATED BY: L2EDMERG
19–Mar–12 PLOT DATE: 19–Mar–12

ATTACHMENT C

INTERSECTION ANALYSIS –EXISTING+ CONSTRUCTION TRAFFIC CONDITIONS

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	2	882	7	17	1243	5	5	2	5	5	2	3
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0			4.0			4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95			1.00			1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.94			0.96	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.98			0.98	
Satd. Flow (prot)	1805	3539	1404	1612	3532			1500			1369	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.95			0.94	
Satd. Flow (perm)	1805	3539	1404	1612	3532			1456			1323	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	2	959	8	18	1351	5	5	2	5	5	2	3
RTOR Reduction (vph)	0	0	4	0	1	0	0	3	0	0	2	0
Lane Group Flow (vph)	2	959	4	18	1355	0	0	9	0	0	8	0
Heavy Vehicles (%)	0%	2%	15%	12%	2%	40%	1%	0%	40%	40%	0%	33%
Turn Type	Prot	NA	Perm	Prot	NA		Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	0.7	28.8	28.8	0.7	28.8			22.2			22.2	
Effective Green, g (s)	0.7	28.8	28.8	0.7	28.8			22.2			22.2	
Actuated g/C Ratio	0.01	0.45	0.45	0.01	0.45			0.35			0.35	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0			4.0			4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	20	1600	635	18	1597			507			461	
v/s Ratio Prot	0.00	0.27		c0.01	c0.38							
v/s Ratio Perm			0.00					0.01			c0.01	
v/c Ratio	0.10	0.60	0.01	1.00	0.85			0.02			0.02	
Uniform Delay, d1	31.2	13.1	9.6	31.5	15.5			13.6			13.6	
Progression Factor	1.00	1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2	2.2	0.6	0.0	212.1	4.4			0.1			0.1	
Delay (s)	33.4	13.7	9.6	243.6	19.9			13.7			13.7	
Level of Service	C	B	A	F	B			B			B	
Approach Delay (s)		13.7			22.9			13.7			13.7	
Approach LOS		B			C			B			B	

Intersection Summary			
HCM Average Control Delay	19.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.49		
Actuated Cycle Length (s)	63.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	44.5%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Volume (vph)	1	1265	4	7	1050	3	6	2	18	3	2	1
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0			4.0			4.0	
Lane Util. Factor	1.00	0.95	1.00	1.00	0.95			1.00			1.00	
Frt	1.00	1.00	0.85	1.00	1.00			0.91			0.98	
Flt Protected	0.95	1.00	1.00	0.95	1.00			0.99			0.98	
Satd. Flow (prot)	1805	3539	1599	1570	3535			1635			1555	
Flt Permitted	0.95	1.00	1.00	0.95	1.00			0.97			0.95	
Satd. Flow (perm)	1805	3539	1599	1570	3535			1600			1509	
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1	1375	4	8	1141	3	7	2	20	3	2	1
RTOR Reduction (vph)	0	0	2	0	0	0	0	13	0	0	1	0
Lane Group Flow (vph)	1	1375	2	8	1144	0	0	16	0	0	5	0
Heavy Vehicles (%)	0%	2%	1%	15%	2%	33%	0%	0%	6%	33%	0%	0%
Turn Type	Prot	NA	Perm	Prot	NA		Perm	NA		Perm	NA	
Protected Phases	7	4		3	8			2			6	
Permitted Phases			4				2			6		
Actuated Green, G (s)	0.7	29.1	29.1	0.7	29.1			22.2			22.2	
Effective Green, g (s)	0.7	29.1	29.1	0.7	29.1			22.2			22.2	
Actuated g/C Ratio	0.01	0.45	0.45	0.01	0.45			0.35			0.35	
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0			4.0			4.0	
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0			3.0			3.0	
Lane Grp Cap (vph)	20	1609	727	17	1607			555			523	
v/s Ratio Prot	0.00	c0.39		c0.01	0.32							
v/s Ratio Perm			0.00					c0.01			0.00	
v/c Ratio	0.05	0.85	0.00	0.47	0.71			0.03			0.01	
Uniform Delay, d1	31.3	15.6	9.5	31.5	14.1			13.8			13.7	
Progression Factor	1.00	1.00	1.00	1.00	1.00			1.00			1.00	
Incremental Delay, d2	1.0	4.7	0.0	19.2	1.5			0.1			0.0	
Delay (s)	32.4	20.2	9.5	50.6	15.6			13.9			13.7	
Level of Service	C	C	A	D	B			B			B	
Approach Delay (s)		20.2			15.8			13.9			13.7	
Approach LOS		C			B			B			B	

Intersection Summary			
HCM Average Control Delay	18.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.50		
Actuated Cycle Length (s)	64.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	45.0%	ICU Level of Service	A
Analysis Period (min)	15		

c Critical Lane Group

ATTACHMENT D
EXISTING CONDITIONS - PEDESTRIAN AND BIKE VOLUMES

PREPARED BY NATIONAL DATA & SURVEYING SERVICES

N/S Street: Project Driveway
E/W Street: Folsom Lake Crossing
DATE: 3/29/2012 DAY: Thursday
CITY: Folsom

	Start	End
AM	7:00	9:00
PM	16:00	18:00

A M

PEDESTRIANS

TIME	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG	
	EB	WB	EB	WB	NB	SB	NB	SB
7:00 AM	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0
7:30 AM	0	0	0	0	0	0	0	0
7:45 AM	0	0	0	0	0	0	0	0
8:00 AM	0	0	1	0	0	0	0	0
8:15 AM	0	0	0	0	0	0	0	0
8:30 AM	0	0	0	0	0	0	0	0
8:45 AM	0	0	0	0	0	0	0	0
TOTALS	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**

BIKES

TIME	TURNING MOVEMENTS											
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR
7:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
7:15 AM	0	0	0	0	0	0	0	0	0	0	2	0
7:30 AM	0	0	0	0	0	0	0	0	0	0	3	0
7:45 AM	0	0	0	0	0	0	0	0	0	0	0	0
8:00 AM	0	0	0	0	0	0	0	0	0	0	0	0
8:15 AM	0	0	0	0	0	0	0	0	0	0	0	0
8:30 AM	0	0	0	0	0	0	0	0	0	0	0	0
8:45 AM	0	0	0	0	0	0	0	1	0	0	0	0
TOTALS	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**5**	**0**

P M

PEDESTRIANS

TIME	NORTH LEG		SOUTH LEG		EAST LEG		WEST LEG	
	EB	WB	EB	WB	NB	SB	NB	SB
4:00 PM	0	0	0	0	0	0	0	0
4:15 PM	0	0	0	0	0	0	0	0
4:30 PM	0	0	0	0	0	0	0	0
4:45 PM	0	0	0	0	0	0	0	0
5:00 PM	0	0	0	0	0	0	0	0
5:15 PM	0	0	0	0	0	0	0	0
5:30 PM	0	0	0	0	0	0	0	0
5:45 PM	0	0	0	0	0	0	0	0
TOTALS	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

BIKES

TIME	TURNING MOVEMENTS											
	NL	NT	NR	SL	ST	SR	EL	ET	ER	WL	WT	WR
4:00 PM	0	0	0	0	0	0	0	3	0	0	3	0
4:15 PM	0	0	0	0	0	0	0	0	0	0	2	0
4:30 PM	0	0	0	0	0	0	0	3	0	0	5	0
4:45 PM	0	0	0	0	0	0	0	2	0	0	1	0
5:00 PM	0	0	0	0	0	0	0	10	0	0	2	0
5:15 PM	0	0	0	0	0	0	0	1	0	0	1	0
5:30 PM	0	0	0	0	0	0	0	3	0	0	0	0
5:45 PM	0	0	0	0	0	0	0	8	0	0	4	0
TOTALS	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**30**	**0**	**0**	**18**	**0**

Appendix H –

State Historic Preservation Officer Coordination

CESPK-PD-RA May 29, 2012

MEMORANDUM FOR RECORD

SUBJECT: Finding of *No potential to cause effects* in compliance with 36 CFR § 800.3(a)(1) and Section 106 of the National Historic Preservation Act of 1966, as amended, for the Joint Federal Project Downstream Features Project in Folsom, California

1. The Downstream Features Project (DFP) includes design refinements to the Joint Federal Project (JFP). The Final Folsom Dam Safety and Flood Damage Reduction Environmental Impact Statement/Environmental Impact Report for the JFP was issued in March 2007. The design refinements for the DFP include the construction of the temporary traffic light, modification to the existing dirt access haul road, installation of the stilling basin drain, and use of the nearby staging area with the installation of a new batch plant to be used and operated in 2017 for downstream features work.

2. The area of potential effects (APE) for the DFP is shown in Enclosure 1. Most of the APE for the DFP is within the APE for the Control Structure, Chute, and Stilling Basin Phase II (Phase II) Project, a component of the JFP under construction by the U.S. Army Corps of Engineers (Corps). The State Historic Preservation Officer (SHPO) concurred with the Corps' finding of *No Adverse Effect* for the Phase II Project in accordance with 36 CFR § 800.5(b) in a letter dated July 26, 2010 (Enclosure 2). The design refinements for the DFP are within the description of the activities for the Phase II Project. The construction of the temporary traffic light will occur on an existing roadway and through soil disturbed within the last five years for the construction of the Folsom Lake Crossing road and bridge. The dirt access haul road will be in an area previously disturbed for construction of the spillway chute and the still basin drain will be constructed in previously disturbed areas or areas of solid rock. A portion of the APE for the DFP, specifically the Folsom State Prison Staging Area, is on fill that was placed on that location in the last five years.

3. The design refinements will all occur in areas previously disturbed for construction of the Phase II Project, areas consisting of fill material, or areas that do not contain previously undisturbed ground. Due to the disturbance within the APE, and previous Section 106 compliance efforts, there is virtually no possibility for the existence of historic properties within the APE.

4. Folsom Dam and Dikes are the only historic properties located near the DFP Project APE. The DFP Project includes features that are largely temporary and would not result in a long term presence. Additionally, Folsom Dam and Dikes are eligible under Criterion A, for its association with important events in history. Construction activities around the dam and dikes would not result in an adverse effect to the criterion that make Folsom Dam and Dikes eligible for listing in the National Register of Historic Places.

5. For previous phases of the JFP when there was a potential effect to historic properties letters were sent to the Shingle Springs Band of Miwok Indians and the United Auburn

Indian Community of the Auburn Rancheria. Because there will be no disturbance to native soil or areas not previously disturbed, and because disturbance is limited to recently created manmade features or through solid rock, it was determined that there is no potential to cause effects to historic properties. Due to the type of activity and the location it was determined that consultation with Native Americans was not required for this project. Additionally, for a previous phase of the Folsom JFP a representative of the Shingle Springs Band of Miwok Indians contacted us to inform us that they are unaware of any traditional cultural properties or sacred sites within or near the project area.

6. The implementing regulations of Section 106 of the National Historic Preservation Act of 1966, as amended (NHPA), 36 CFR § 800.3(a)(1), *No potential to cause effects*, allow a federal agency to determine "If the undertaking is the type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under Section 106 of this part." Due to the previous disturbance from construction within the APE and because no activities described for the DFP Project will occur in undisturbed ground, the DFP Project will not have the potential to cause effects to historic properties.

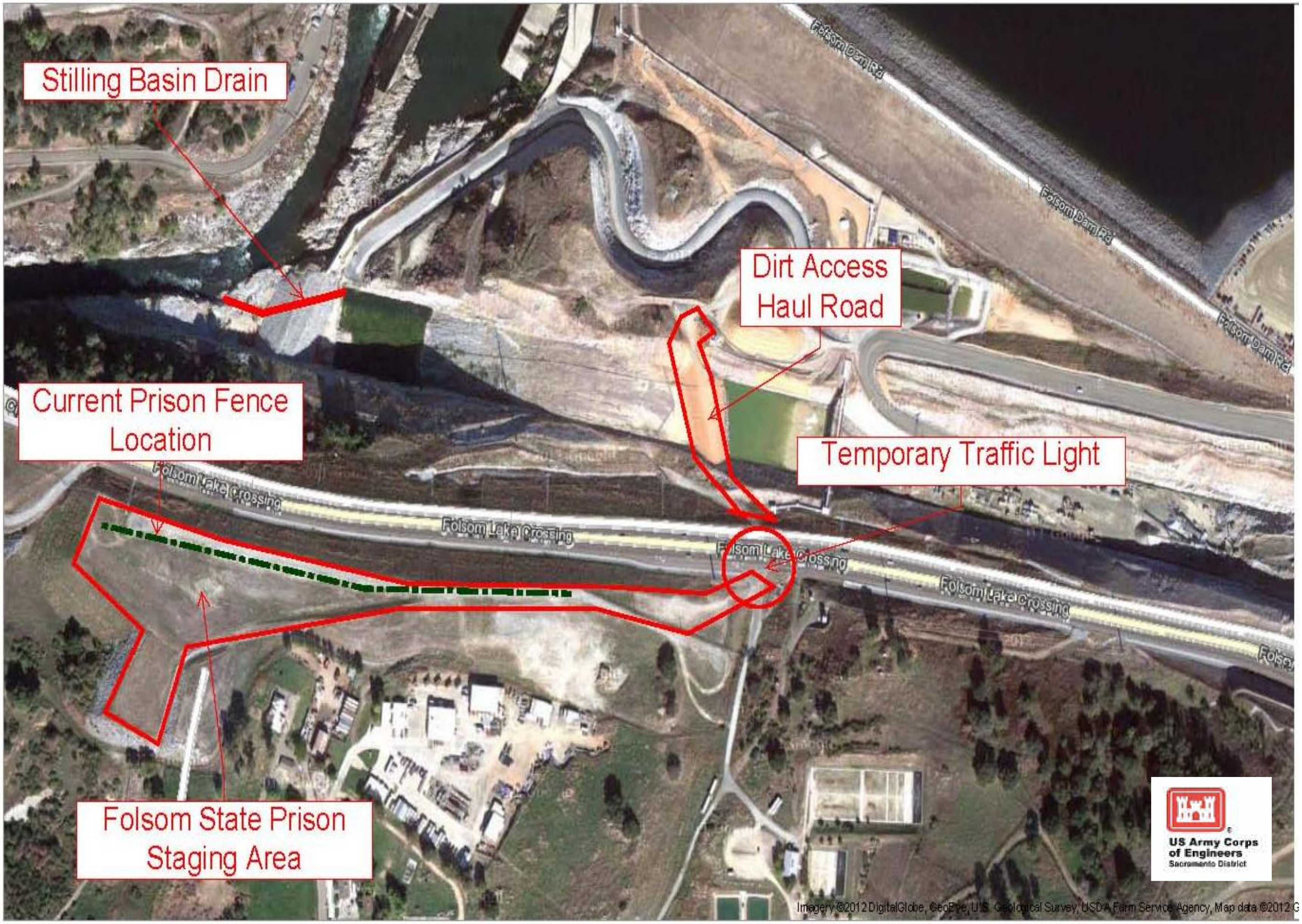
7. All required actions have been satisfactory completed toward compliance with Section 106. The full measure and intent of 36 CFR 800.4(a)(1) have been met. Therefore, the Corps has determined that the DFP Project is in compliance with Section 106 of the NHPA and may proceed as planned.

Melissa Montag
Historian
Cultural, Recreational, & Social Assessment Section

Enclosure 1

Area of Potential Effects for the Folsom Dam Safety/
Flood Damage Reduction Project

Project Features



Enclosure 2

Correspondence with the State Historic Preservation Officer
for Control Structure, Chute, and Stilling Basin Phase II Project
July 26, 2010

STATE OF CALIFORNIA – THE RESOURCES AGENCY ARNOLD SCHWARZENEGGER, *Governor*

OFFICE OF HISTORIC PRESERVATION
DEPARTMENT OF PARKS AND RECREATION
1725 23rd Street, Suite 100
SACRAMENTO, CA 95816-7100
(916) 445-7000 Fax: (916) 445-7053
calshpo@parks.ca.gov
www.ohp.parks.ca.gov

July 26, 2010

In Reply Refer To: COE081120C

Alicia E. Kirchner
Chief, Planning Division
Department of the Army
U.S. Army Engineer District, Sacramento
1325 J Street
Sacramento, California 95814-2922

Re: Continued Consultation Regarding the Control Structure, Chute, and Stilling Basin for Phase II, Folsom Dam Joint Federal Project, Flood Damage Reduction (JFP-FDR); Sacramento County, California.

Dear Ms. Kirchner:

Thank you for continuing consultation with my office regarding the Folsom Dam Joint Federal Project. The U.S. Army Corps of Engineers (COE), Sacramento District, is seeking my concurrence on the effects that the proposed undertaking will have regarding historic properties pursuant to 36 CFR Part 800 (as amended 8-05-04) regulations implementing Section 106 of the National Historic Preservation Act (NHPA). Previously in this consultation (SHPO letter of December 10, 2008) I concurred that your determination of an Area of Potential Effects (APE) was appropriate pursuant to 36 CFR Part 800.4(a)(1) and in my letter of May 5, 2009, I concurred with your finding of No Adverse Effect for Phase I of this undertaking. At this time, in your letter (and attachments) of July 19, 2010, you are requesting my consultation regarding your finding of effect for Phase II of the Control Structure, Chute, and Stilling Basin component of the Flood Damage Reduction measures for the Folsom Dam Joint Federal Project.

The identification efforts by the COE have determined that two historic properties are located in the project APE. Folsom Dam, which has been determined to be eligible for the National Register of Historic Places (NRHP) under criterion A, has numerous elements located within and adjacent to the APE. The second historic property, PLI-FDEIS-1, is an historic mining feature with an adit, spoils piles and drainage, that is located near the proposed borrow disposal and storage area for the project. The COE has determined that PLI-FDEIS-1 will be avoided by the proposed project. In addition, the COE has determined that the construction of the project will not alter the characteristics of Folsom Dam that qualified it for eligibility for the NRHP, and has concluded that a finding of No Adverse Effect is appropriate pursuant to 36 CFR Part 800.5(b).

After reviewing your letter and supporting documentation, I concur that the Area of Potential Effects determined by the COE is appropriate pursuant to 36 CFR Part

Appendix I –

Comments and Responses

Comments and Responses
on
Draft EA/EIR for Folsom Dam Safety and Flood Damage Reduction
Prison Staging Area and Stilling Basin Drain
September 2012

No.	Agency	Comment	Response
1.	U.S. Bureau of Reclamation	"FONSI, page 4, and generally throughout the document: A portion of the lands used by the Folsom State Prison actually belong to the Bureau of Reclamation and not the prison. Please see the attached map for approximate property lines. The yellow parcels belong to Reclamation."	Discussion on page 1 has been revised to include the following: "Although most of the 10 acres is Folsom State Prison land, a small area portion near the driveway is actually Federal land owned by Reclamation. For this EA/EIR, the entire 10-acre area is referred to as "Folsom State Prison land" since the prison currently has an easement to use Reclamation's land."
2.	U.S. Bureau of Reclamation	"Page 4: Mentions a conveyor belt but I didn't see any discussion of it in the rest of the document. Did the 2010 EA/EIR assume that a conveyor belt would be used to transport material across Folsom Lake Crossing?"	The 2010 EA/EIR assumed that concrete would be transported by truck or a conveyor system across the spillway access road. The effects and BMPs of a conveyor system crossing the spillway access road are assumed to be similar to the proposed conveyor system across Folsom Lake Crossing.
3.	U.S. Bureau of Reclamation	"Page 6: Where will the power come from? Prison land, BOR land? Will a power drop or pole need to be installed?"	Discussion on page 6 has been revised to indicate that the power for the temporary signal would come from the prison via overhead power poles that would be installed as a part of the project.
4.	U.S. Bureau of Reclamation	"Page 13, Visual Resources: Folsom Dam is also a primary aesthetic resource."	Discussion on page 13 has been revised to provide additional details regarding the dam as an aesthetic resource.
5.	U.S. Bureau of Reclamation	"Page 14: Says there won't be impacts to birds in the stilling basin. What about cliff swallows? They nest all over the facility."	While effects on birds in the stilling basin are not anticipated, the basin area would be included in the preconstruction surveys that would be conducted prior to any work scheduled during the nesting season. Discussion on page 14 has been revised to indicate that the migratory cliff swallow would be included in the surveys.
6.	U.S. Bureau of Reclamation	"Page 15, VELB: Request that a pre-construction survey be conducted for VELB. Many of the elderberry bushes that were removed have grown back."	Discussion on page 15 has been revised to include the following: "To ensure that there would be no effect, pre-construction surveys would be conducted by qualified biologists in areas that may contain suitable habitat for special-status plant, invertebrate, or wildlife species. The biologists would identify locations of special status plant, invertebrate, or wildlife species. If the biologists identify any of these special status

			species or suitable habitat, the Corps would contact the USFWS regarding any necessary measures to provide protection.”
7.	U.S. Bureau of Reclamation	“Page 32, Table 5: Since a conveyor belt will be in operation for the duration of the project it might be helpful to include the noise emissions for it.”	Table 5 has been revised to include a decibel range for a conveyor.
8.	U.S. Bureau of Reclamation	“Page 43: Would the off-street parking be off-project?”	Yes, if the contractor decides that additional parking space is necessary, off-street parking would be outside of the project area. Discussion on page 45 has been revised accordingly.
9.	U.S. Bureau of Reclamation	“Page 44: Will the prison and stilling basin operate under the same stormwater permit as the rest of the site?”	The entire Folsom JFP Phase IV site (chute and stilling basin) would be under the same construction stormwater permit. The concrete batch plant would have a separate industrial stormwater permit. Preparation work on the Folsom State Prison land would be conducted by a pre-Phase IV contractor, who would obtain a construction general permit. Once the Phase IV contractor receives a notice to proceed and has an approved SWPPP, they would submit an application for a new permit application for the entire site (chute, stilling basin, and prison staging area). Once the Phase IV stormwater permit has been obtained, the pre-Phase IV contractor would terminate their stormwater permit.
10.	U.S. Bureau of Reclamation	“Page 46: How will the drain be constructed adjacent to the river? How will it be accessed “	Discussion on page 49 has been revised to include the following: “Access to the stilling basin drain site would be via the internal haul road. The drain would be constructed landside by excavating the open cut trench while leaving in a plug at the river end. Once the trench is completed, the plug would then be removed.”
11.	U.S. Bureau of Reclamation	“Was the city coordinated with on traffic issues?”	Yes, and coordination with the City of Folsom will continue until the Folsom JFP is completed. In addition, the contractor would be required to submit a traffic handling plan to the City for approval prior to initiation of construction.
12.	U.S. Bureau of Reclamation	“Air Quality: How are you justifying not including the emissions from this part of the project with the rest of the work? I wouldn't consider the prison staging and stilling basin to be separate actions. If you leave it that way it would be helpful to include a paragraph that explains the logic of looking at the air quality impacts from different components of the project separately.”	Discussion on page 63 includes cumulative effects analysis to air quality. The addition of emissions from the proposed design refinements to the emissions from the other phases of the Folsom JFP would be considered to be a cumulative effect. SMAQMD’s approach to thresholds of significance is relevant to whether a project’s individual emissions would result in a cumulatively considerable adverse contribution to the Sacramento Valley Air Basin’s existing air quality conditions. According to SMAQMD “If a project’s emissions would be less than these levels, the project would not be expected to

			result in a cumulatively considerable contribution to the significant cumulative effect" to the Sacramento Valley Air Basin's existing air quality. Emissions from the proposed design refinements are well below GCR de minimus values for criteria pollutants and therefore would not be considered to have a significant cumulative effect. In addition, the 2010 EA/EIR analyzed emissions from the construction of the control structure, chute, and stilling basin. Modeling showed that with mitigation, construction would not produce emissions that are greater than the GCR *de minimus* values for criteria pollutants.
13.	U.S. Bureau of Reclamation	"Will Folsom Lake Crossing be closed at any point for installation of the traffic light or re-striping of the road?"	Interruption to Folsom Lake Crossing is anticipated to be minimal during installation of the temporary traffic light. The contractor is required to submit a traffic handling plan to the City for approval prior to initiation of construction.
14.	U.S. Fish and Wildlife Service	"The Service recommends the Corps: 1. Avoid impacts to any oak woodlands and riparian areas outside, but in close proximity to, the construction easement and staging areas by fencing their boundaries with orange construction fencing or cyclone fencing just outside of the dripline of the woody vegetation. 2. Avoid impacts to nesting migratory birds by clearing any riparian or seasonal wetland vegetation during the summer months after any nesting birds young-of-the year have fledged. 3. Minimize impacts to fish and wildlife resources and their habitat by confining travel to established roads/paths in the project area and confining parking to established areas (parking lots and staging areas). 4. Minimize impacts to wildlife by seeding all disturbed areas these areas with annual grasses at the completion of construction or when currently disturbed areas are going to remain unused for the growing season."	These recommendations have been incorporated into the project. Discussion on page 15 has been revised to include the recommendations.
15.	CA Dept of Corrections and Rehabilitation	"Although the EIR addresses the prospect of increased traffic, it does not consider the critical need for unobstructed emergency vehicle access to and from the prison grounds via this northern entrance. The proposed access would not be sufficient during times of high volume traffic. Blockage of the intersection and entry is a potential risk of the intended use. The design of the intersection, entry, and traffic light system should be examined and, if necessary, adjusted to ensure that full access, including emergency access, is guaranteed at all times."	The inbound lane would be widened by 12 feet. As currently designed, the contractor would not block the inbound lane into the prison driveway at the stop-bar of the outbound lane at the intersection. Construction traffic would have some effects to the outbound lane since exiting trucks would need to turn right onto Folsom Lake Crossing. However, in the event of an emergency, movement of construction traffic would cease to ensure that emergency vehicles would have unobstructed access. Discussion on page 44 has been revised accordingly.

16.	CA Dept of Corrections and Rehabilitation	"If the proposed COCR project is approved, construction is expected to begin in FY 2014-2015 and, in that event, the site would require access for the public, contractors, and material suppliers from Folsom Lake Crossing. …the prison access road would require widening by an additional two lanes for approximately 1,100 linear feet."	Coordination between the Corps and CDCR would continue throughout the lease agreement. If the COCR project is approved and when a schedule and design for the COCR project have been established, coordination efforts would ensure minimal traffic effects due to concurrent construction activities. This coordination would also avoid or minimize any adverse effects on the Corps project schedule.
17.	Central Valley Regional WQ Control Board	"Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore our comments will address concerns surrounding those issues."	All required permits related to water quality would be obtained by the contractor prior to initiation of construction. The contractor would also ensure that permit requirements are implemented during construction.
18.	Sac Metro AQ Management District	"Including the Basic Construction Emission Control Practices for the project is appreciated."	Thank you for your comment.
19.	Sac Metro AQ Management District	"The SMAQMD recommends Enhanced Exhaust Control Practices also be included since this construction work is part of the larger Folsom JFP and the mitigation adopted for the Folsom JFP (which is similar to the Enhanced Exhaust Control Practices) should apply to this work. The Enhanced Exhaust Control Practices are attached."	Discussion on pages 24-25 has been revised to include the Enhanced Exhaust Control Practices.
20.	Sac Metro AQ Management District	"The final EA/EIR should include the complete Roadway Construction Emissions Model run to fully disclose the assumptions used to conduct the emission calculations."	Appendix D has been revised to include the complete Roadway Construction Emissions Model spreadsheet.
21.	Sac Metro AQ Management District	"The Methodology section on page 21 describes the use of the Roadway Construction Emissions Model. Additional description should be included in this section on data inputs chosen for the model run."	Discussion on pages 21-22 has been revised to provide additional details regarding the data entered into the model.
22.	Sac Metro AQ Management District	"CARB's interim GHG significance thresholds are discussed on pages 27 and 29 but the actual numeric threshold applied to this project was not included in the discussion."	Discussion on page 31has been revised to include the CARB interim threshold of 7,000 metric tons of CO2e/yr.
23.	Sac Metro AQ Management District	"Including measures to reduce the project's carbon emissions is appreciated, although the wording that the measures could be implemented should be changed to will be implemented."	Discussion on page 24 has been revised to state that the contractor would implement the proposed mitigation measures.
24.	Sac Metro AQ Management	"SMAQMD rules apply to all projects at the time of construction. A list of the most common rules that apply to construction is attached. A complete list of all SMAQMD rules is available at www.airquality.org	Thank you for providing this information.

	District	or by calling 916-874-4800."	
25.	United Auburn Indian Community of the Auburn Rancheria	"In order to ascertain whether or not the project could affect cultural resources that may be of importance to the UAIC, we would like to receive copies of any archaeological reports that have been, or will be, completed for the project."	An MFR documenting a *No potential to cause effects* determination in compliance with 36 CFR § 800.3(a)(1) and Section 106 was prepared for this project and included as an appendix to the EA/EIR. An additional copy will be sent to the UAIC.
26.	United Auburn Indian Community of the Auburn Rancheria	"We also request copies of future environmental documents for the proposed project so that we have the opportunity to comment on potential impacts and proposed mitigation measures related to cultural resources."	The UAIC will continue to be on the mailing list and will be notified if future environmental documents are prepared.
27.	United Auburn Indian Community of the Auburn Rancheria	"The UAIC would also like the opportunity to have our tribal monitors accompany you during the field survey."	Because all ground-disturbing activities for the project are occurring in previously disturbed areas and areas previously used for staging and access, no archeological field survey was required for this project.
28.	United Auburn Indian Community of the Auburn Rancheria	"In the future please give us our right to comment on and review an undertaking in the spirit of good faith government to government consultation."	In previous correspondence for the Corps' JFP Project, which is within the same area, the UAIC has indicated that they do not have archeological concerns. The implementing regulations of Section 106 of the National Historic Preservation Act of 1966, as amended, 36 CFR § 800.3(a)(1), *No potential to cause effects*, allow a Federal agency to determine that "If the undertaking is the type of activity that does not have the potential to cause effects on historic properties, assuming such historic properties were present, the agency official has no further obligations under Section 106 of this part." Due to the previous construction disturbance within the APE, lack of JFP Project activities in undisturbed ground, and UAIC's previous indication that they do not have archeological concerns in the area, the Corps determined that the JFP Project would not have the potential to affect historic properties. However, the UAIC will continue to be on the mailing list and will be notified and offered an opportunity to comment on any future environmental documents.
29.	United Auburn Indian Community of the Auburn Rancheria	"Keep in mind that if any unanticipated or inadvertent discoveries, or change in project activities occur, the Tribe may have additional responsibilities for this undertaking under 36 CFR Part 800."	Discussion on page 58 includes proposed mitigation in the event that unanticipated or inadvertent discoveries are made.

Hi Jamie,

My comments are as follows:

FONSI, page 4, and generally throughout the document: A portion of the lands used by the Folsom State Prison actually belong to the Bureau of Reclamation and not the prison. Please see the attached map for approximate property lines. The yellow parcels belong to Reclamation.

Page 4: Mentions a conveyor belt but I didn't see any discussion of it in the rest of the document. Did the 2010 EA/EIR assume that a conveyor belt would be used to transport material across Folsom Lake Crossing?

Page 6: Where will the power come from? Prison land, BOR land? Will a power drop or pole need to be installed?

Page 13, Visual Resources: Folsom Dam is also a primary aesthetic resource.

-Page 14: Says there won't be impacts to birds in the stilling basin. What about cliff swallows? They nest all over the facility.

-Page 15, VELB: Request that a pre-construction survey be conducted for VELB. Many of the elderberry bushes that were removed have grown back.

-Page 32, Table 5: Since a conveyor belt will be in operation for the duration of the project it might be helpful to include the noise emissions for it.

-Page 43: Would the off-street parking be off-project?

-Page 44: Will the prison and stilling basin operate under the same stormwater permit as the rest of the site?

-Page 46: How will the drain be constructed adjacent to the river? How will it be accessed?

General Comments/ Questions:

-Was the city coordinated with on traffic issues?

-Air Quality: How are you justifying not including the emissions from this part of the project with the rest of the work? I wouldn't consider the prison staging and stilling basin to be separate actions. If you leave it that way it would be helpful to include a paragraph that explains the logic of looking at the air quality impacts from different components of the project separately.

-Will Folsom Lake Crossing be closed at any point for installation of the traffic light or re-striping of the road?

Thanks!
Chelsea Stewart
Natural Resource Specialist
Bureau of Reclamation
(916)989-7155

United States Department of the Interior

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

In Reply Refer To:
08ESMF00-2012-CPA-0169

AUG 20 2012

Alicia Kirchner
Chief, Planning Division
U.S. Army Corps of Engineers, Sacramento District
13325 J Street
Sacramento, California 95814-2922

Dear Ms. Kirchner:

The U.S. Fish and Wildlife Service (Service) has been working closely with the Corps of Engineers (Corps) on the Folsom Dam Safety and Flood Damage Reduction Project since its inception. Most recently we have been involved in the Prison Staging and Stilling Basin Drain aspects of the project which involves disturbance to lands previously disturbed by construction activities associated with the overall work at the Folsom Facility.

We have completed our review of the *Draft Environmental Assessment/Environmental Impact Report and Draft Finding of No Significant Impact for the Folsom Dam Safety and Flood Damage Reduction Project, Prison Staging and Stilling Basin Drain.* The Service provides the following recommendations under the authority of the Fish and Wildlife Coordination Act.

The Service recommends the Corps:

1. Avoid impacts to any oak woodlands and riparian areas outside, but in close proximity to, the construction easement and staging areas by fencing their boundaries with orange construction fencing or cyclone fencing just outside of the dripline of the woody vegetation.

2. Avoid impacts to nesting migratory birds by clearing any riparian or seasonal wetland vegetation during the summer months after any nesting birds young-of-the year have fledged.

3. Minimize impacts to fish and wildlife resources and their habitat by confining travel to established roads/paths in the project area and confining parking to established areas (parking lots and staging areas).

4. Minimize impacts to wildlife by seeding all disturbed areas these areas with annual grasses at the completion of construction or when currently disturbed areas are going to remain unused for the growing season.

If you have any questions regarding the recommendations or Service involvement in this project, please contact Doug Weinrich at (916) 414-6563.

Sincerely,

Doug Weinrich

for Daniel Welsh
Assistant Field Supervisor

cc:
Jamie LeFevre, COE, Sacramento, CA
Howard Brown, NOAA Fisheries, Sacramento, CA
Regional Manager, CDFG, North Central Region, Rancho Cordova, CA

FACILITY PLANNING, CONSTRUCTION AND MANAGEMENT
P.O. Box 942883
Sacramento, CA 94283-0001

August 27, 2012

Ms. Jamie LeFevre, Environmental Manager
U.S. Army Corps of Engineers
1325 J Street
Sacramento, CA 95814

Dear Ms. LeFevre:

COMMENTS ON FOLSOM DAM SAFETY AND FLOOD DAMAGE REDUCTION SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT AND ENVIRONMENTAL IMPACT REPORT

The U.S. Army Corps of Engineers (USACE) proposes to lease (for a five-year term) an approximately 10-acre area on the grounds of Folsom State Prison (FSP) to locate a staging area and concrete batch plant for the Folsom Dam Safety and Flood Damage Reduction Project (hereinafter referred to as the Folsom Dam Safety Project). Use of FSP property for the Folsom Dam Safety Project will require approval by the California Department of Corrections and Rehabilitation (CDCR) and California Department of General Services as Responsible Agencies under the California Environmental Quality Act (CEQA) and as Cooperating Agencies under the National Environmental Policy Act (NEPA). While CDCR supports this important project to improve the safety, security, and flood damage reduction features of the Folsom Dam and its associated facilities, CDCR has specific concerns about the proposed lease area's potential environmental, security, and safety impacts to the prison's operations due to the size and volume of heavy truck traffic, which CDCR has reason to believe will cause significant traffic congestion and require additional measures to ensure against any derogation of prison security.

Discussion

The Folsom Dam Safety Project will involve substantial heavy traffic (in both vehicle size and volume) to and from the north entrance of FSP onto Folsom Lake Crossing. For reasons discussed below, CDCR is deeply concerned that the use of the property at FSP as part of the Folsom Dam Safety Project will cause significant effects to prison operations related to high traffic, security, congestion, and risks of injury that are inherent in heavy construction activities. CDCR requests that USACE make modifications to the site that will mitigate these potential impacts. The following comments are submitted for your review.

<u>Prison Operations and Programs</u>

The Environmental Assessment/Environmental Impact Report (EA/EIR) (July 2012) states that the staging area would be used for administrative office space, construction worker parking, material storage, stock piling, construction vehicle storage and maintenance, aggregate storage, and concrete batching (p. 4). The majority of the proposed lease area is along a corridor adjacent to Folsom Lake Crossing. As described in the EA/EIR, there would be only one single point of access to the proposed lease area at the existing prison entry road. This entry point would be used by all construction traffic accessing the batch plant and staging area, as well as prison traffic and emergency vehicles.

The EA/EIR (p. 5-6) states that a temporary traffic signal would be installed at the Folsom Lake Crossing/FSP access road, Folsom Lake Crossing would be re-striped to create a dedicated turn lane to the FSP access road entrance, and the prison entrance would be widened leading into the staging area to provide a turning radius for construction vehicles. These proposed measures, while necessary, would not be sufficient to alleviate impacts of the Folsom Dam Safety Project's construction traffic on the prison access road and the prison's operations. Although the EIR addresses the prospect of increased traffic, it does not consider the critical need for unobstructed emergency vehicle access to and from the prison grounds via this northern entrance. The proposed access would not be sufficient during times of high volume traffic. Blockage of the intersection and entry is a potential risk of the intended use. The design of the intersection, entry, and traffic light system should be examined and, if necessary, adjusted to ensure that full access, including emergency access, is guaranteed at all times.

The FSP driveway at Folsom Lake Crossing is the rear entrance to FSP. While it is not the main prison entrance, it is the location of a number of important prison facilities and is a critical entry point for prison staff and other personnel who must have unimpeded access throughout the day.

The rifle range, Inmate/Ward Labor (IWL) program, FSP and California State Prison – Sacramento (CSP-Sac) are accessed from the FSP driveway. The rifle range is used for training exercises by FSP and CSP-Sac staff as well as by local law enforcement departments, including the city of Folsom Police Department and local sheriff's department. IWL and private contractors use the rear driveway to access the IWL lay down yard and for special projects constructed at both prisons. FSP and CSP-Sac operate three shifts in each 24-hour period, so custody staff travel through this driveway throughout the day. The prison access road accommodates not only prison staff but also must be accessible to emergency vehicles, as mentioned above.

The batch plant operations for the Folsom Dam Safety Project will require vast amounts of material deliveries for the production of cement. Ingress and egress to the batch plant will be provided at only one point, at the rear (north) entrance to the prison. The USACE has not finalized any decision on how it will deliver the concrete manufactured at the batch plant across the highway to the spillway component of the Folsom Dam Safety Project. USACE informed CDCR that either an underground or overhead pipe is under consideration. USACE is also considering trucking the cement across the highway. Should drilling under the road for an underground pipeline or the installation of an overhead method of delivery not be viable, concrete trucks would have to be used to deliver the material. These heavy material and concrete trucks would enter and exit over the rear prison road and travel across Folsom Lake Crossing to enter the spillway site, resulting in an even greater effect upon FSP and surrounding roads.

<u>Proposed Prison Project</u>

The fiscal year (FY) 2012-2013 California Budget Act has authorized CDCR to construct a limited number of Level II adult male dormitory facilities at up to three existing prison locations. Construction of these facilities would assist CDCR in complying with federal court requirements to reduce inmate overcrowding in its prisons. FSP is being considered for a 792-bed dormitory facility at the land adjacent to the proposed USACE lease area. CDCR is currently conducting a feasibility study of the site.

If the proposed CDCR project is approved, construction is expected to begin in FY 2014-2015 and, in that event, the site would require access for the public, contractors, and material suppliers from Folsom Lake Crossing. The prison access road, therefore, would be required to accommodate not only current FSP traffic for its numerous existing operations, but also for construction traffic for the proposed CDCR infill project and for the Folsom Dam Safety Project, all within the same timeframe. Furthermore, pursuant to State requirements, FSP would need to have both a union labor gate and a non-union labor gate for its proposed infill project. Because three construction gates would be required (union labor gate, non-union labor gate, and USACE project gate), the prison access road would require widening by an additional two lanes for approximately 1,100 linear feet. The proposed CDCR infill project would also require a staging area for materials and vehicle storage. The road widening would be necessary to ensure emergency access as well as to reduce congestion and the risk of vehicle accidents on the existing narrow road that was not designed to accommodate this high level of use.

Conclusion

In conclusion, CDCR reiterates its support for this important project to improve the safety, security, and flood damage reduction features of the Folsom Dam and its associated facilities. However, CDCR must preserve the safety and security of its institution and the community and must continue to effectively facilitate the daily functions of its prisons. The potential effects of project construction traffic on FSP operations were not analyzed in the EA/EIR and should be addressed.

Due to the potentially significant effects to prison operations from the size and volume of heavy truck traffic and, further, as a Responsible Agency under CEQA and a Cooperating Agency under NEPA, CDCR looks forward to working with USACE on changes to the proposed staging area that will mitigate impacts to CDCR operations. Future correspondence for this project should be addressed to Nancy MacKenzie, Environmental Planning Section; Facility Planning, Construction and Management; California Department of Corrections and Rehabilitation; 9838 Old Placerville Road, Suite B, Sacramento, CA 95827; or nancy.mackenzie@cdcr.ca.gov. Ms. MacKenzie can also be reached at 916-255-2159.

Thank you for the opportunity to provide comments on the proposed Folsom Dam Safety Project. We look forward to discussing our concerns with you.

Sincerely,

DEBORAH HYSEN
Deputy Director
Facility Planning, Construction and Management

cc: Chris Meyer, Director, Facility Planning, Construction and Management
Brian Covey, Associate Director (A), Design and Environmental Services and Standards Branch
Nancy MacKenzie, Supervising Environmental Planner

17 August 2012

David Martasian
Central Valley Flood Protection Board
3310 El Camino Avenue, Room 151
Sacramento, CA 95821

CERTIFIED MAIL
7011 2970 0003 8939 1460

COMMENTS TO THE DRAFT SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT/SUPPLEMENTAL ENVIRONMENTAL IMPACT REPORT, FOLSOM DAM SAFETY & FLOOD DAMAGE REDUCTION - PRISON STAGING AREA & STILLING BASIN DRAIN PROJECT, SCH NO. 2006022091, SACRAMENTO COUNTY

Pursuant to the State Clearinghouse's 12 July 2012 request, the Central Valley Regional Water Quality Control Board (Central Valley Water Board) has reviewed the *Draft Supplemental Environmental Assessment/Supplemental Environmental Impact Report* for the Folsom Dam Safety & Flood Damage Reduction - Prison Staging Area & Stilling Basin Drain Project, located in Sacramento County.

Our agency is delegated with the responsibility of protecting the quality of surface and groundwaters of the state; therefore our comments will address concerns surrounding those issues.

Construction Storm Water General Permit

Dischargers whose project disturb one or more acres of soil or where projects disturb less than one acre but are part of a larger common plan of development that in total disturbs one or more acres, are required to obtain coverage under the General Permit for Storm Water Discharges Associated with Construction Activities (Construction General Permit), Construction General Permit Order No. 2009-009-DWQ. Construction activity subject to this permit includes clearing, grading, grubbing, disturbances to the ground, such as stockpiling, or excavation, but does not include regular maintenance activities performed to restore the original line, grade, or capacity of the facility. The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP).

For more information on the Construction General Permit, visit the State Water Resources Control Board website at:
http://www.waterboards.ca.gov/water_issues/programs/stormwater/constpermits.shtml.

Phase I and II Municipal Separate Storm Sewer System (MS4) Permits[1]

The Phase I and II MS4 permits require the Permittees reduce pollutants and runoff flows from new development and redevelopment using Best Management Practices (BMPs) to the maximum extent practicable (MEP). MS4 Permittees have their own development standards, also known as Low Impact Development (LID)/post-construction standards that include a hydromodification component. The MS4 permits also require specific design concepts for LID/post-construction BMPs in the early stages of a project during the entitlement and CEQA process and the development plan review process.

For more information on which Phase I MS4 Permit this project applies to, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/municipal_permits/.

Industrial Storm Water General Permit

Storm water discharges associated with industrial sites must comply with the regulations contained in the Industrial Storm Water General Permit Order No. 97-03-DWQ.

For more information on the Industrial Storm Water General Permit, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/water_issues/storm_water/industrial_general_permits/index.shtml.

Clean Water Act Section 404 Permit

If the project will involve the discharge of dredged or fill material in navigable waters or wetlands, a permit pursuant to Section 404 of the Clean Water Act may be needed from the United States Army Corps of Engineers (USACOE). If a Section 404 permit is required by the USACOE, the Central Valley Water Board will review the permit application to ensure that discharge will not violate water quality standards. If the project requires surface water drainage realignment, the applicant is advised to contact the Department of Fish and Game for information on Streambed Alteration Permit requirements.

If you have any questions regarding the Clean Water Act Section 404 permits, please contact the Regulatory Division of the Sacramento District of USACOE at (916) 557-5250.

[1] Municipal Permits = The Phase I Municipal Separate Storm Water System (MS4) Permit covers medium sized Municipalities (serving between 100,000 and 250,000 people) and large sized municipalities (serving over 250,000 people). The Phase II MS4 provides coverage for small municipalities, including non-traditional Small MS4s, which include military bases, public campuses, prisons and hospitals.

Clean Water Act Section 401 Permit – Water Quality Certification

If an USACOE permit, or any other federal permit, is required for this project due to the disturbance of waters of the United States (such as streams and wetlands), then a Water Quality Certification must be obtained from the Central Valley Water Board prior to initiation of project activities. There are no waivers for 401 Water Quality Certifications.

Waste Discharge Requirements

If USACOE determines that only non-jurisdictional waters of the State (i.e., "non-federal" waters of the State) are present in the proposed project area, the proposed project will require a Waste Discharge Requirement (WDR) permit to be issued by Central Valley Water Board. Under the California Porter-Cologne Water Quality Control Act, discharges to all waters of the State, including all wetlands and other waters of the State including, but not limited to, isolated wetlands, are subject to State regulation.

For more information on the Water Quality Certification and WDR processes, visit the Central Valley Water Board website at:
http://www.waterboards.ca.gov/centralvalley/help/business_help/permit2.shtml.

If you have questions regarding these comments, please contact me at (916) 464-4684 or tcleak@waterboards.ca.gov.

Trevor Cleak
Environmental Scientist

cc: State Clearinghouse Unit, Governor's Office of Planning and Research, Sacramento

July 31, 2012

SENT VIA E-MAIL ONLY

Ms. Jamie LeFevre
Environmental Manager
U. S. Army Corps of Engineers Sacramento District
1325 J Street
Sacramento, CA 95814

Folsom Dam Safety and Flood Damage Reduction Project, Prison Staging Area and Stilling Basin Drain, Draft Environmental Assessment/Environmental Impact Report (SAC200500806h)

Dear Ms. LeFevre:

Thank you for providing the Draft Environmental Assessment/Environmental Impact Report for the Folsom Dam Safety and Flood Damage Reduction Project (JFP), Prison Staging Area and Stilling Basin Drain to the Sacramento Metropolitan Air Quality Management District (SMAQMD). The report focuses on minor construction and design refinements that supplement the 2007 Final EIS/EIR for the Folsom JFP issued by the Bureau of Reclamation. SMAQMD staff comments follow.

1. Including the Basic Construction Emission Control Practices for the project is appreciated.
2. The SMAQMD recommends Enhanced Exhaust Control Practices also be included since this construction work is part of the larger Folsom JFP and the mitigation adopted for the Folsom JFP (which is similar to the Enhanced Exhaust Control Practices) should apply to this work. The Enhanced Exhaust Control Practices are attached.
3. The final EA/EIR should include the complete Roadway Construction Emissions Model run to fully disclose the assumptions used to conduct the emission calculations.
4. The Methodology section on page 21 describes the use of the Roadway Construction Emissions Model. Additional description should be included in this section on data inputs chosen for the model run.
5. CARB's interim GHG significance thresholds are discussed on pages 27 and 29 but the actual numeric threshold applied to this project was not included in the discussion.
6. Including measures to reduce the project's carbon emissions is appreciated, although the wording that the measures could be implemented should be changed to will be implemented.
7. SMAQMD rules apply to all projects at the time of construction. A list of the most common rules that apply to construction is attached. A complete list of all SMAQMD rules is available at www.airquality.org or by calling 916-874-4800.

You may contact me at 916-874-4881 or khuss@airquality.org if you have any questions or need clarification regarding this letter.

Sincerely,

Karen Huss
Associate Air Quality Planner/Analyst

Attachments

Cc: Larry Robinson, SMAQMD

Attachment
Enhanced Exhaust Control Practices

- The project shall provide a plan for approval by the lead agency and District demonstrating that the heavy-duty (50 horsepower [hp] or more) off-road vehicles to be used in the construction project, including owned, leased, and subcontractor vehicles, will achieve a project wide fleet-average 20% NO_X reduction and 45% particulate reduction compared to the most recent California Air Resources Board (ARB) fleet average. Acceptable options for reducing emissions may include use of late model engines, low-emission diesel products, alternative fuels, engine retrofit technology, after-treatment products, and/or other options as they become available. The District's Construction Mitigation Calculator can be used to identify an equipment fleet that achieves this reduction.

- The project representative shall submit to the lead agency and District a comprehensive inventory of all off-road construction equipment, equal to or greater than 50 horsepower, that will be used an aggregate of 40 or more hours during any portion of the construction project. The inventory shall include the horsepower rating, engine model year, and projected hours of use for each piece of equipment. The inventory shall be updated and submitted monthly throughout the duration of the project, except that an inventory shall not be required for any 30-day period in which no construction activity occurs. At least 48 hours prior to the use of subject heavy-duty off-road equipment, the project representative shall provide SMAQMD with the anticipated construction timeline including start date, and name and phone number of the project manager and on-site foreman. The District's Model Equipment List can be used to submit this information.

- The project shall ensure that emissions from all off-road diesel powered equipment used on the project site do not exceed 40% opacity for more than three minutes in any one hour. Any equipment found to exceed 40 percent opacity (or Ringelmann 2.0) shall be repaired immediately. Non-compliant equipment will be documented and a summary provided to the lead agency and District monthly. A visual survey of all in-operation equipment shall be made at least weekly, and a monthly summary of the visual survey results shall be submitted throughout the duration of the project, except that the monthly summary shall not be required for any 30-day period in which no construction activity occurs. The monthly summary shall include the quantity and type of vehicles surveyed as well as the dates of each survey. The District and/or other officials may conduct periodic site inspections to determine compliance. Nothing in this section shall supercede other District or state rules or regulations.

- If at the time of construction, the District has adopted a regulation applicable to construction emissions, compliance with the regulation may completely or partially replace this mitigation. Consultation with the District prior to construction will be necessary to make this determination.

Attachment

SMAQMD Rules & Regulations Statement (revised 3/12)

*The following statement is recommended as standard condition of approval or construction document language for **all** development projects within the Sacramento Metropolitan Air Quality Management District (SMAQMD):* All projects are subject to SMAQMD rules in effect at the time of construction. A complete listing of current rules is available at www.airquality.org or by calling 916.874.4800. Specific rules that may relate to construction activities or building design may include, but are not limited to:

Rule 201: General Permit Requirements. Any project that includes the use of equipment capable of releasing emissions to the atmosphere may require permit(s) from SMAQMD prior to equipment operation. The applicant, developer, or operator of a project that includes an emergency generator, boiler, or heater should contact the SMAQMD early to determine if a permit is required, and to begin the permit application process. Portable construction equipment (e.g. generators, compressors, pile drivers, lighting equipment, etc.) with an internal combustion engine over 50 horsepower are required to have a SMAQMD permit or a California Air Resources Board portable equipment registration. Other general types of uses that require a permit include, but are not limited to dry cleaners, gasoline stations, spray booths, and operations that generate airborne particulate emissions.

Rule 403: Fugitive Dust. The developer or contractor is required to control dust emissions from earth moving activities, storage or any other construction activity to prevent airborne dust from leaving the project site.

Rule 414: Water Heaters, Boilers and Process Heaters Rated Less Than 1,000,000 BTU PER Hour. The developer or contractor is required to install water heaters (including residence water heaters), boilers or process heaters that comply with the emission limits specified in the rule.

Rule 417: Wood Burning Appliances. This rule prohibits the installation of any new, permanently installed, indoor or outdoor, uncontrolled fireplaces in new or existing developments.

Rule 442: Architectural Coatings. The developer or contractor is required to use coatings that comply with the volatile organic compound content limits specified in the rule.

Rule 460: Adhesives and Sealants. The developer or contractor is required to use adhesives and sealants that comply with the volatile organic compound content limits specified in the rule.

Rule 902: Asbestos. The developer or contractor is required to notify SMAQMD of any regulated renovation or demolition activity. Rule 902 contains specific requirements for surveying, notification, removal, and disposal of asbestos containing material.

Naturally Occurring Asbestos: The developer or contractor is required to notify SMAQMD of earth moving projects, greater than 1 acre in size in areas “Moderately Likely to Contain Asbestos” within eastern Sacramento County. Asbestos Airborne Toxic Control Measures, Section 93105 & 93106 contain specific requirements for surveying, notification, and handling soil that contains naturally occurring asbestos.

MIWOK
MAIDU
United Auburn Indian Community
of the Auburn Rancheria

David Keyser, Chairman | Kimberly DuBach, Vice Chair | Gene Whitehouse, Secretary | Brenda Adams, Treasurer | Calvin Moman, Council Member

August 31, 2012

Jamie LeFevre
Environmental Manager
1325 J Street
Sacramento, California 95814

Subject: Draft EA/EIR and Draft No Significant Impact for the Folsom Dam Safety and Flood Damage Reduction Project, Prison Staging Area and Stilling Basin Drain Project, Located in Folsom, California

Dear Ms. LeFevre,

Thank you for requesting information regarding the above referenced project. The United Auburn Indian Community (UAIC) of the Auburn Rancheria is comprised of Miwok and Southern Maidu (Nisenan) people whose tribal lands are within Placer County and ancestral territory spans into El Dorado, Nevada, Sacramento, Sutter, and Yuba counties. The UAIC is concerned about development within its aboriginal territory that has potential to impact the lifeways, cultural sites, and landscapes that may be of sacred or ceremonial significance. We appreciate the opportunity to comment on this and other projects in your jurisdiction.

In order to ascertain whether or not the project could affect cultural resources that may be of importance to the UAIC, we would like to receive copies of any archaeological reports that have been, or will be, completed for the project. We also request copies of future environmental documents for the proposed project so that we have the opportunity to comment on potential impacts and proposed mitigation measures related to cultural resources. The UAIC would also like the opportunity to have our tribal monitors accompany you during the field survey. The information gathered will provide us with a better understanding of the project and cultural resources on site and is invaluable for consultation purposes.

We continue to ask for archaeological and cultural resources reporting and management conditions to include gathering ethnographic and ethnohistorical information. This is one of the most beneficial forms of Native American study that can yield significant information on historic and traditional cultural properties. The Memorandum of Record included for review states that, "Due to the type of activity and the location it was determined that consultation with Native Americans was not required for this project." At no time shall the lack of information gathered from a previous undertakings consultation be circumvented due to a compliance finding or eligibility determination. It is the Tribes legal write to comment and often the turnaround in staff, acquisition of new data, or willingness of informants to come forward lead to premature or incomplete conclusions. In the future please give us our right to comment on and review an undertaking in the spirit of good faith government to government consultation.

Keep in mind that if any unanticipated or inadvertent discoveries, or change in project activities occur, the Tribe may have additional responsibilities for this undertaking under 36 CFR Part 800. Thank you again for taking these matters into consideration, and for involving the UAIC early in the planning process. We look forward to reviewing any additional documents as requested. Please contact Marcos Guerrero, Tribal Historic Preservation Officer, at (530) 883-2364 or email at mguerrero@auburnrancheria.com if you have any questions.

Sincerely,

David Keyser,
Chairman

CC: Marcos Guerrero, THPO

Appendix J –

CEQA Mitigation, Monitoring, and Reporting Plan

MITIGATION, MONITORING, AND REPORTING PLAN

FOLSOM DAM SAFETY AND FLOOD DAMAGE REDUCTION PRISON STAGING AREA AND STILLING BASIN DRAIN

SACRAMENTO COUNTY, CALIFORNIA

This mitigation monitoring or reporting plan (MMRP) is designed to fulfill Section 21081.6 (a) of the California Public Resources Code (CEQA). Section 21081.6 (a) requires that public agencies adopt a reporting or monitoring program whenever a project or program is approved that includes mitigation measures identified in an environmental document for which the agency makes a finding pursuant to CEQA Section 21081 (a) (1). The mitigation measures and strategies described below and in the attached table are to be used to avoid, minimize, or reduce any potentially significant environmental impacts.

The MMRP table includes the following:

- Section and Impacts – identifies the issue area section of the Supplemental Environmental Assessment/Environmental Impact Report (SEA/EIR) and corresponding impact.
- Mitigation Measures – lists the adopted mitigation measures from the SEA/EIR.
- Implementation Timing – identifies the timing of implementation of the action described in the mitigation measures.
- Responsible for Implementation – identifies the agency/party responsible for implementing the actions described in the mitigation measures.
- Responsible for Monitoring /Reporting Action– identifies the agency/party responsible for monitoring implementation of the actions described in the mitigation measures. Verification will be carried-out during the project and a MMRP completion report will be submitted to the CVFPB upon completion of the project.

Notes:
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Section and Impacts	Mitigation Measures	Implementation Timing	Responsible for Mitigation	Responsible for Monitoring/ Reporting Action
3.3.1 – Air Quality Construction activities would result in short term air emissions of ROG, NOx, CO, CO2, PM10 & PM2.5 and Diesel particulate matter that are less than the significant thresholds. However, due to the non-attainment zone of Sacramento County with respect to O3, PM10, and PM2.5, Sacramento Metropolitan Air Quality Management District (SMAQMD) has recommended projects within the Sacramento Valley Air Basin implement a set of Basic Construction Emissions Control Practices as BMPs and a set of Enhanced Exhaust Control Practices to reduce hydrocarbon emissions.	The Basic Construction Emission Control Practices that would be implemented by the contractor during the construction project are the following: • Water all exposed surfaces two times daily. Exposed surfaces include, but are not limited to soil piles, graded areas, unpaved parking areas, staging areas, and access roads. • Cover or maintain at least two feet of free board space on haul trucks transporting soil, sand, or other loose material on the site. Any haul trucks that would be traveling along freeways or major roadways should be covered. • Use wet power vacuum street sweepers to remove any visible trackout mud or dirt onto adjacent public roads at least once a day. Use of dry power sweeping is prohibited. • Limit vehicle speeds on unpaved roads to 15 miles per hour (mph). • All roadways, driveways, sidewalks, parking lots to be paved should be completed as soon as possible. In addition, building pads should be laid as soon as possible after grading unless seeding or soil binders are used. • Minimize idling time either by shutting equipment off when not in use or reducing the time of idling to five minutes (as required by the state airborne toxics control measure [Title 13, Section 2485 of	D, C	Contractor, USACE	SMAQMD, CVFPB Verify Air Quality plan submittal to USACE and SMAQMD. Verify emission reduction measures and BMP's are in place and implemented. Verify SMAQMD has received the Off-road equipment inventory

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Section and Impacts	Mitigation Measures	Implementation Timing	Responsible for Mitigation	Responsible for Monitoring/ Reporting Action
	the California Code of Regulations]). Provide clear signage that posts this requirement for workers at the entrances to the site. • Maintain all construction equipment in proper working condition according to manufacturer's specifications. The equipment must be checked by a certified mechanic and determine to be running in proper condition before it is operated. In addition, SMAQMD recommends that the project implement a set of Enhanced Exhaust Control Practices to further reduce hydrocarbon emissions. The Enhanced Exhaust Control Practices that would be implemented by the contractor during construction include the following: • Provide a plan for approval by the lead agency and SMAQMD demonstrating that the heavy-duty (50 horsepower [hp] or more) off-road vehicles to be used in the construction project, including owned, leased, and subcontractor vehicles, would achieve a project-wide fleet-average 20 percent NOX reduction and 45 percent particulate reduction compared to the most recent California Air Resources Board (ARB) fleet average. Acceptable options for reducing emissions may include use of late model engines, low-emission diesel products, alternative fuels, engine retrofit technology, after-treatment products, and/or other options as they become available. The SMAQMD's Construction Mitigation Calculator can be used to identify an equipment fleet that achieves this reduction.			

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	• Submit to the lead agency and SMAQMD a comprehensive inventory of all off-road construction equipment, equal to or greater than 50 hp, that would be used an aggregate of 40 or more hours during any portion of the construction project. The inventory would include the horsepower rating, engine model year, and projected hours of use for each piece of equipment. The inventory would be updated and submitted monthly throughout the duration of the project, except that an inventory would not be required for any 30-day period in which no construction activity occurs. At least 48 hours prior to the use of subject heavy-duty off-road equipment, the contractor would provide SMAQMD with the anticipated construction timeline including start date, and name and phone number of the project manager and on-site foreman. The SMAQMD's Model Equipment List can be used to submit this information. • Ensure that emissions from all off-road diesel-powered equipment used on the project site do not exceed 40 percent opacity for more than 3 minutes in any 1 hour. Any equipment found to exceed 40 percent opacity (or Ringelmann 2.0) would be repaired immediately. Non-compliant equipment would be documented and a summary provided to the lead agency and SMAQMD monthly. A visual survey of all in-operation equipment would be made at least weekly, and a monthly summary of the visual survey results would be submitted throughout the duration of			

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	the project, except that the monthly summary would not be required for any 30-day period in which no construction activity occurs. The monthly summary would include the quantity and type of vehicles surveyed as well as the dates of each survey. The SMAQMD and/or other officials may conduct periodic site inspections to determine compliance. Nothing in this section would supercede other SMAQMD or State rules or regulations. • If at the time of construction, SMAQMD has adopted a regulation applicable to construction emissions, compliance with the regulation may completely or partially replace this mitigation. Consultation with the SMAQMD prior to construction would be necessary to make this determination.			
3.3.2 Climate Change Construction activities would result in a net increase of GHG emissions over a finite period – approximately 4 months for construction and 4 years for the operation of the batch plant. Emissions are expected to be below the reporting levels of the U.S. Environmental Protection Agency of 25,000 metric tons of CO2 equivalents / year and CARBs interim threshold of 7,000 mtCO2e/year. Emissions; • would not conflict with Federal, State, or local goals to reduce GHGs • will be avoided or reduced through	Since there would be no significant effects on climate change, no mitigation would be required. However, the following measures would be implemented by the contractor to reduce any GHG emissions from construction of the design refinements. • Improve fuel efficiency from construction equipment by minimizing idling time either by shutting equipment off when not in use or reducing the time of idling to no more than three minutes (five minute limit is required by the state airborne toxics control measure [Title 13, Section 2485 of the California Code of Regulations]).	D, C	Contractor, USACE	USACE, CVFPB Verify that GHG reduction measures are being implemented.

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implementation of BMPs into the design of the project Mitigation measures will be implemented by the contractor to reduce GHG emissions from the project.	Provide clear signage that posts this requirement for workers at the entrances to the site. • Maintain all construction equipment in proper working condition according to manufacturer's specifications. The equipment must be checked by a certified mechanic and determined to be running in proper condition before it is operated. • Use equipment with new technologies (repowered engines, electric drive trains). • Perform on-site material hauling with trucks equipped with on-road engines (if determined to be less emissive than the off-road engines). • Encourage and provide carpools, shuttle vans, transit passes and/or secure bicycle parking for construction worker commutes. • Produce concrete on-site if determined to be less emissive than transporting ready mix.			
3.3.3 – Noise & Vibration There would be no significant effects from the construction project on noise or vibration, and therefore no mitigation would be required. Most construction noise impacts are short term, temporary and would occur during the City of Folsom's allowed construction hours which are exempt from exterior noise standard limits (7:00 a.m. to 6:00 p.m. during weekdays and 8:00 a.m. to 5:00 p.m. on weekends).	Since there would be no significant effects on noise or vibration, no mitigation would be required. However, the following measures would be implemented by the contractor during construction activities in order to further reduce any potential noise effects: • Appropriate level of sound attenuation would be used during construction to meet local ordinances. Potential sound attenuations measures that could be considered include, but not limited to, temporary sound barriers near the	D, P, C	Contractor, USACE	USACE, CVFPB Verify the contractor has notified all sensitive receptors within the project area Verify that all noise & vibration

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The concrete batch plant may operate outside of the non-exempt hours (6 pm – 7am) but the sources of the noise levels would occur far enough from sensitive receptors that the noise is attenuated below ambient noise levels	noise source or otherwise places between the sources of construction noise and noise-sensitive receptors, as appropriate. • Residents and businesses near the project area would be provided with advance notices of project activities, schedule, anticipated traffic, and potential noise issues. The advance notice would describe the potential noise disruption and the steps that would be taken to minimize the noise. • The construction contractor would monitor noise from construction activity. In the event that construction noise exceeds the City of Folsom's thresholds, corrective actions would be taken to reduce the noise levels or stop the activity. • Heavy truck deliveries would be scheduled during exempt working hours and whenever possible, avoid deliveries during a single hour, especially during non-exempt hours. Haul trucks operating near noise sensitive receptor sites would be spaced apart to avoid noise effects from simultaneous operation. • Engine brake (jake brake) use within city limits would be prohibited. Many noise complaints arise from heavy truck use of engine brakes to slow the truck down. Use of this type of braking can be avoided by proper speed control. • The contractor would properly maintain and tune engines of all equipment and maintain properly			measures are implemented Verify construction activities occur within the designated hours or if outside of exempt hours, verify City of Folsom's noise ordinances are being met.

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	functioning mufflers on all internal combustion engines to minimize noise levels.			
3.3.4 - Traffic • Slow moving trucks leaving and entering the staging and construction areas through the intersection could present a hazard to higher speed traffic on Folsom Lake Crossing. • Construction vehicles would not block the inbound lane into the prison driveway but the outbound lane would experience some traffic delays due to trucks exiting right onto Folsom Lake Crossing.	• Installation of a traffic signal would stop traffic at Folsom Lake Crossing and allow the slower moving truck traffic to enter the intersection without causing a safety hazard • In the event of an emergency, movement of construction traffic would cease to ensure that emergency vehicles would have unobstructed access in and out of the northern prison entrance. Since there would be no significant effects on traffic, no mitigation would be required. Implementation of the following measures by the contractor would help to ensure public safety during construction. • Construction zones along residential roadways would be posted to notify approaching motorists of trucks entering and exiting roadside construction sites and to reduce speeds through the construction zone. • Before and during construction, signs would be placed at construction areas to notify users of ongoing construction and limits of use. • All speed limits, traffic laws, and transportation	D, C	Contractor, USACE	CVFPB, USACE Verify Traffic Control Plan has been approved by the City of Folsom Verify traffic control measures are implemented.

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	regulations would be obeyed during construction. • On-street parking for construction workers would be prohibited. • Off-street parking would be identified and provided to the construction workers and their vehicles and trucks. If possible, parking would be close enough to walk to the site.			
3.3.5 Water Resources and Quality Construction Activities may impact adjacent waterways by: 1) Increasing turbidity through site erosion and sedimentation	In order to maintain existing water quality conditions and beneficial uses, the contractor would be required to obtain NPDES permits, implement the required and standard BMPs and SWPPP, and implement, the measures in the Spill Prevention and Response Plan (SPRP) and the Erosion and Sediment Control Plan (ESCP) • A NPDES Construction Storm Water Permit from the CVRWQCB would be required since the project would disturb more than 1 acre of land. The Construction Storm Water Permit pertains to the prevention of increased turbidity of adjacent waterways from site erosion and sedimentation. The contractor would be required to design and implement a SWPPP prior to initiating construction activities, and to implement standard BMPs. Dust control measures would be implemented to avoid dust and soil from entering	D, C	Contractor, USACE	CVFPB Verify NPDES permit has been obtained. Verify SWPPP and SPRP & ESCP has been obtained and BMP's are implemented.

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	the river or other drainages as a result of construction activities. Precautions would be followed to avoid erosion and movement of soils into drainage systems. Implementation of BMPs and NPDES permit requirements would reduce water quality impacts from construction to less than significant			
2) Discharge of pollution from the Concrete Batch Plant	• The NPDES Industrial Storm Water Permit requires that a SWPPP is designed and implemented specific to the concrete batch plant operation. Debris, oil and fuel, or concrete mix material spills pertaining to the concrete batch plant site could adversely affect water quality. The industrial storm water permit addresses potential pollution inputs due to storm water runoff that are associated with all activities at the concrete batch plant. The contractor would be required to cover and control all material stock piles to prevent suspension of dust or concrete mix material due to wind. The contractor would also be required to coordinate the handling of all wastewaters generated from concrete production with the CVRWQCB. For the concrete batch plant installed at the Folsom State Prison staging area, the implementation of BMPs and NPDES permit requirements would reduce water quality impacts to less than significant.			

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3) Fugitive dust	Frequent watering of haul routes, proper covering and control of material stock piles (e.g., dirt and aggregate) would help to prevent fugitive dust pollution impacts.			
4) Construction of the stilling basin drain	To avoid impacts to water quality, the stilling basin drain would be constructed landside by excavating the open cut trench while leaving in a plug at the river end. Once the trench is completed, the plug would then be removed. Since there would be no significant effects on water resources or quality, no mitigation would be required. However, the following standard BMPs would be implemented to avoid or minimize any effects of construction on surface waters. Standard BMPs include; • Appropriate erosion control measures would be incorporated into the SWPPP in order to prevent sediment from entering waterways. Examples include, but are not limited to: straw bales/wattles, erosion blankets, silt fencing, mulching, re-vegetation, and temporary covers. An appropriately designed and effective sediment capture and stilling basin must be implemented to capture and control sediments carried by site runoff. Sediment and erosion control measures must be maintained during construction at all times. Inspect control measures before, during, and after a rain event. • Implement appropriate measures to prevent any debris, soil, rock, or other materials/products associated with construction activities from			

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	entering waterways. The contractor would use a water truck or other appropriate measures to control fugitive dust on haul roads, construction areas, and stockpiles. • A concrete and fuel spill management plan would be developed for the project. • Provide secondary containment for storage of any fuel, oil or other liquid and properly dispose of such liquid wastes. • Fuel and maintain vehicles in specified staging areas only, which are designed to capture potential spills. These areas cannot be near any ditch, stream, or other body of water or feature that may convey water to a nearby body of water. • Fuels and hazardous materials would not be stored on site. Any spills of hazardous material would be cleaned up immediately. Spills would be reported in construction compliance reports. • Inspect and maintain vehicles and equipment to prevent dripping of oil, lubricants, or any other fluids. • Schedule construction to avoid as much of the wet season as possible. Ground disturbance activities are expected to begin in the summer of 2013. If rains are forecast during the construction period, erosion control measures would be implemented.			

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	• Train construction personnel in storm water pollution prevention practices. • Re-vegetate and restore areas cleared by construction in a timely manner to control erosion. • Implementation of any additional requirements as mandated by either the construction storm water permit, industrial storm water permit, or the limited threat discharge permit would further reduce any potential adverse affects to adjacent waterways. In addition, the measures in the Spill Prevention and Response Plan and the Erosion and Sediment Control Plan would prevent any significant adverse effects to water quality in the project area. The inclusion of the above mitigation measures and complete compliance with all water quality permits, would reduce any water resources and water quality impacts to a less than significance.			
3.3.6 Fisheries Construction of the spillway drain could potentially affect fish species inhabiting the outflow channel, or Lake Natoma through sediment collecting in the stilling basin and entering the river. The potential adverse effects on fisheries in the project area resulting from the design refinements would be indirect, resulting from short-term water quality degradation.	Mitigation measures for fisheries are the same as those listed for water quality and resources in Section 3.3.5 of the final SEA/EIR. In summary, compliance with the various water quality permits needed for this project, including implementation of the SWPPP and its associated BMPs, would reduce potential, indirect effects to less-than-significant.	D, C,	Contractor, USACE	CVFPB Verify NPDES permit has been obtained. Verify SWPPP and SPRP & ESCP has been obtained and BMP's are implemented.

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3.3.7 - Recreation Installation of the temporary traffic signal and widening of an existing dirt access road would restrict recreational access along the bike trail. Widening of the existing dirt access road would, for approximately 1 week, require limited access to the bike trail for approximately 70 feet at the north intersection of Folsom Lake Crossing.	In order to reduce impacts to recreation, detour routes and ADA-compliant temporary ramps would be constructed as needed. To ensure public safety, warning signs and signs restricting access would be posted before and during construction, as necessary. Detour routes would be clearly marked, and fences erected in order to prevent access to the project area. Public outreach would be conducted through mailings, posting signs, coordination with interested groups, and meetings, if necessary, in order to provide information regarding changes to recreational access. A temporary path would be constructed to allow recreationalists to safely pass the work zone.	C	Contractor, USACE	CVFPB Verify with USACE that the contractor has implemented detour routes correctly, implemented public safety measures and public outreach measures
3.3.8 – Cultural Resources Construction activities are not expected to impact cultural resources. However, if any potential significant cultural resources are discovered during construction, then the following mitigation measures will be implemented.	Should any potentially significant cultural resources be discovered during construction, all ground-disturbing activities would cease in the area of the discovery, and take action as required by 36 CFR 800.13(b), "discoveries without prior planning". Data recovery or other mitigation measures could be necessary to mitigate adverse effects to significant properties. Implementation of mitigations measures, which could include avoidance and recordation or evaluation of a previously unidentified historic property by a qualified archeologist, would reduce these effects to less than significance.	C	Contractor, USACE	CVFPB Verify with USACE that activities have been halted if cultural resources are discovered

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By: William H Edgar Date: 10-10-2012

William Edgar

President

By: [signature] Date: 10-11-2012

Jane Dolan

Secretary

Notes:

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