UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213

April 17, 2012

In Response, refer to:
2011/05794

David Valenstein
Chief, Environment & Systems Planning Division
U.S. Department of Transportation
Federal Railroad Administration
1200 New Jersey Avenue, SE
Washington, DC 20590

Dear Mr. Valenstein:

Enclosed is NOAA's National Marine Fisheries Service's (NMFS) conference and biological opinion (BO) (Enclosure 1) based on the Service's review of the proposed California High-Speed Train (HST) System for the Merced to Fresno section located in Merced, Madera and Fresno counties of California, and its effects on Central Valley (CV) spring-run Chinook salmon (*Oncorhynchus tshawytscha*) and California Central Valley (CCV) steelhead (*O. mykiss*) in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your initial request for formal section 7 consultation on this project was received on November 30, 2011. On December 1, 2011, formal consultation was initiated by NMFS' Central Valley Office.

This BO is based on information provided in the biological assessment (BA) for the Merced to Fresno section provided on November 30, 2011, the draft Environmental Impact Statement, the Biological Resources and Wetlands Technical Report for the Merced to Fresno section provided on August 25, 2011, and the technical memorandum that refines the San Joaquin bridge crossing portion of the BA received by NMFS December 12, 2011. Due to the San Joaquin River Restoration Program (SJRRP) and its mandate to have an experimental designated population of CV spring-run Chinook salmon below Friant Dam near Fresno, California no later than December 31, 2012, as part of the NRDC, *et al.*, v. Kirk Rodgers, *et al.* 2006 settlement agreement, this will also serve as a conference opinion for that species as well as a BO for the CCV steelhead.

Based on the best available scientific and commercial information, the BO concludes that the HST, as presented by the Federal Railroad Administration, is not likely to jeopardize the continued existence of the listed species. NMFS anticipates that the proposed project will

result in the incidental take of CCV steelhead and CV spring-run Chinook salmon. An incidental take statement that includes reasonable and prudent measures and non-discretionary terms and conditions that are expected to minimize the impact of the anticipated incidental take of CV steelhead and CV spring-run Chinook is included with the BO.

This letter also transmits NMFS' Essential Fish Habitat (EFH) conservation recommendations for Pacific salmon as required by the Magnuson-Stevens Fishery Conservation and Management Act as amended (16 U.S.C. 1801 *et seq.*; Enclosure 2). The document concludes that the HST Merced to Fresno section will adversely affect the EFH of Pacific salmon in the action area and adopts certain terms and conditions of the incidental take statement and the ESA conservation recommendations of the biological opinion as the EFH conservation recommendations.

Please contact Sierra Franks at our Central Valley Office at (916) 930-3720, or via e-mail at Sierra.Franks@noaa.gov, if you have any questions regarding this response or require additional information.

Sincerely,

FOR Rodney R. McInnis
Regional Administrator

Enclosures (2)

cc: NMFS-PRD, Long Beach, CA
Dan Russell, USFWS, Sacramento, CA
Dan Leavitt, California High Speed Rail Authority, Sacramento, CA
Copy to Administrative File: 151422SWR2011SA00573

Enclosure 1

BIOLOGICAL and CONFERENCE OPINION

ACTION AGENCY: Federal Railroad Administration & California High Speed Rail Authority

ACTION: High Speed Train: Merced - Fresno

CONSULTATION CONDUCTED BY: Southwest Region, National Marine Fisheries Service

FILE NUMBER: 151422SWR2011SA00573 (TN/2011/05794)

DATE ISSUED: **April 17, 2012**

I. CONSULTATION HISTORY

The U.S. Department of Transportation Federal Railroad Administration (FRA) along with the California High-Speed Rail Authority (HSRA) is proposing to construct the Merced to Fresno section of the California High-Speed Train (HST) in Merced, Madera and Fresno counties in California. The HST Merced to Fresno section is one section in a total of ten that will create a state-wide high speed rail infrastructure, connecting major metropolitan areas such as Los Angeles, San Francisco and Sacramento. The Merced to Fresno section will consist of approximately 80 miles of track, 2 railroad passenger stations, approximately 42 road overcrossings and undercrossing, associated railway support facilities, and will allow the HSR to travel at speeds up to 220 miles per hour.

On September 23, 2009, the HSRA requested technical assistance regarding potential effects from the Merced to Fresno section on special-status anadromous fish pursuant to section 7 of the ESA, as well as the effects on Essential Fish Habitat (EFH) of the Magnuson-Stevens Act (MSA).

On January 5, 2010, the HSRA met with the National Marine Fisheries Service (NMFS) to discuss the project. At this meeting it was determined that additional information should be gathered before determining if the proposed actions could affect special-status fish. It was also initially determined that California Central Valley (CCV) steelhead (*Oncorhynchus mykiss*) and Central Valley (CV) spring-run Chinook salmon (*Oncorhynchus tshawytscha*) may need to be analyzed for potential effects.

On November 17, 2010, the HSRA requested a species list from NMFS. On February 1, 2011, a species letter was sent from NMFS indicating that at the time construction begins on the HST the San Joaquin River Restoration Program will have been implemented and the HST should

consider its effects on CCV steelhead and CV spring-run Chinook salmon as well as EFH for CV spring-run Chinook salmon.

On March 14, 2011, the FRA sent a memorandum of understanding to NMFS and USFWS designating the HSRA to act on behalf of the FRA as a non-federal representative.

On June 14, 2011, an agency coordination meeting took place with representatives from the HSRA, NMFS, the United States Fish and Wildlife Service (USFWS), California Department of Fish and Game (CDFG) and the U.S. Environmental Protection Agency (EPA) to discuss the approach for the BA and the anticipated timeframe.

On August 25, 2011, NMFS received a draft EIR/EIS and a Biological Resources and Technical Report.

On September 2, 2011, a meeting with NMFS, USFWS and the HSRA took place to address the draft Biological Resources and Wetlands Technical report and the BA approach and schedule.

On October 17, 2011, NMFS received a draft BA for the Merced to Fresno section.

On October 27, 2011, a meeting with the HSRA, NMFS and USFWS occurred to discuss findings and issues with the draft BA.

On October 31, 2011, consultants with AECOM under direction from the HSRA met with NMFS to discuss details about the bridge crossing over the San Joaquin River.

On November 22, 2011, a meeting with HSRA, NMFS, CDFG, EPA, U.S. Army Corps of Engineers, U.S. Bureau of Reclamation (BOR), California Department of Water Resources (CDWR), and consultants from AECOM, CH2M Hill, Parsons Brinckerhoff and URS met to discuss mitigation measures for the proposed high speed rail for the sections of Merced to Fresno and Fresno to Bakersfield.

On November 30, 2011, NMFS, USFWS, CDFG, CDWR and BOR met with the HSRA to discuss modifications to the bridge crossing over the San Joaquin River from its current proposal in the BA. That same day a BA package for the Merced to Fresno section was delivered in person to NMFS initiating formal consultation.

On December 7, 2011, the HSRA, NMFS, USFWS and consultants from AECOM and URS met to discuss the Services initial review of the BA.

On December 12, 2011, NMFS received a memorandum to the BA regarding the San Joaquin River Crossing Design Refinement – Merced to Fresno section.

On December 20, 2011, NMFS asked for additional clarification on a few details regarding the bridge crossing over the San Joaquin River. On December 30, 2011, a consultant from AECOM working with the FRA/HSRA replied to these questions via e-mail.

On January 10, 2012, additional information was requested by NMFS regarding temporary bridge support work.

On January 12, 2012, a meeting with representatives with AECOM was held at the NMFS office to discuss temporary bridge support work.

On February 8, 2012, a meeting with CDFG, USFWS, HSR consultants and NMFS occurred to discuss pertinent questions from agencies.

On March 2, 2012, a meeting with CDFG, USFWS, HSRA and NMFS occurred to discuss how the BO was progressing.

On March 5, 2012, the bi-monthly federal family meeting involving NMFS, USFWS, Army Core of Engineers, Environmental Protection Agency, Bureau of Reclamation, and Department of Transportation occurred to discuss any questions that may be relevant to all agencies.

On March 29, 2012, AECOM a contractor for the HSRA, provided specific latitude and longitude coordinates for the San Joaquin bridge crossing that were requested by NMFS.

II. DESCRIPTION OF THE PROPOSED ACTION

A. Construction Activities

The FRA in conjunction with the HSRA is proposing to build a high speed train system in California that will connect major metropolitan hubs, and other large cities of the central valley that have limited connectivity currently. The final project will consist of ten separate sections, that can function independently, but joined together will create a large state-wide HST system. This BO addresses one section, the Merced to Fresno section, located in Merced, Madera and Fresno counties, California. The proposed HST involves constructing an electrically powered, steel-wheel-on-steel rail system with the state -of-the-art safety, signaling, and automated train-control systems. The HST would be capable of operating at speeds up to 220 miles per hour over fully grade-separated, dedicated track alignment. A portion of this section is a large span bridge crossing over the San Joaquin River near the city of Fresno, California. The proposed HST bridge will be upstream and parallel to the existing highway 99 bridge and BNSF/UPRR Railroad Bridge. This consultation package is for a 15 percent design-build plan of the Merced to Fresno section, including the San Joaquin River Bridge crossing.

The soffit, or lowest portion of the structure spanning the waterway, would be a minimum of 10 to 15 feet above the top bank on both sides of the river, providing ample passage for flood flows and wildlife. The section of the elevated structure or guideway that crosses the San Joaquin River is anticipated to be supported on foundations consisting of cast-in-drilled-hole (CIDH) with cast-in-place concrete column extensions. The preliminary design submitted with the BA depicts the use of two basic foundations; a single large [12-14 feet] diameter CIDH pile with a reinforced concrete column extension and a reinforced concrete footing supported by 4 or more 8’ diameter CIDH piles.

The estimated acreage affected is equal to the column cross-section area above the finished grade. A reasonable preliminary estimate for the area of the CIDH/Column extension is between 75-125 square feet (sf), depending on the diameter used. A larger column would be required to support the ends of the long spans, with probable cross-sectional areas varying between 300-500 sf, depending on the configuration of the structure type. The concept described in the memorandum to the BA regarding the San Joaquin River Crossing Design Refinement – Merced to Fresno section would result in less than .05 acres of permanent effect.

Temporary false work is anticipated to contain approximately 35 to 40 two foot diameter steel pipes. These pipes will be placed at least 50 feet apart from each other across the river channel. These pipes will be placed no more than 50 feet in width from the centerline of the proposed bridge, as this is the current Right of Way. This anticipates that approximately 5 to 8 pipes will be required for one temporary support structure. Temporary supports will be placed using a vibratory hammer and will be put in during one in-water work window season and removed the next window (June 1 – October 15). Temporary supports will be placed to withstand winter flows and contracted employees may be required to enter the stream bed to assist in guiding the pipes in place.

Currently, the UPRR railway and the Caltrans SR 99 bridge structures downstream from the feature crossing have piers in the San Joaquin River corridor that are spaced approximately 160 feet apart. The HST bridge design uses a combination of the typical precast segmental construction at each approach to the crossing and then spans the main flow channel with a 160 to 320-foot steel truss superstructure to minimize the need to enter the wetted perimeter of the low-flow river channel.

Where required, the construction of foundations within the edge of the active waterway would use construction methods such as installation of sheet pile cofferdams to isolate the activity from the live stream in order to avoid or minimize the potential for adverse effects on listed fish within the action area. In addition, both temporary and permanent steel casings for cast-in-drilled-hole pile construction and piling for falsework will use a vibratory hammer for installation, which will minimize underwater sound pressures.

The number of foundation elements is directly related to the span arrangement necessary to meet the requirements for bridge hydraulics. Since the future crossing will be located upstream of the two existing bridge structures, the hydraulic effect of the placement of the new piers within the river corridor on downstream structures and the geomorphology of the channel will be considered during the final configuration of the structure. Refer to figure 1 for further clarification.

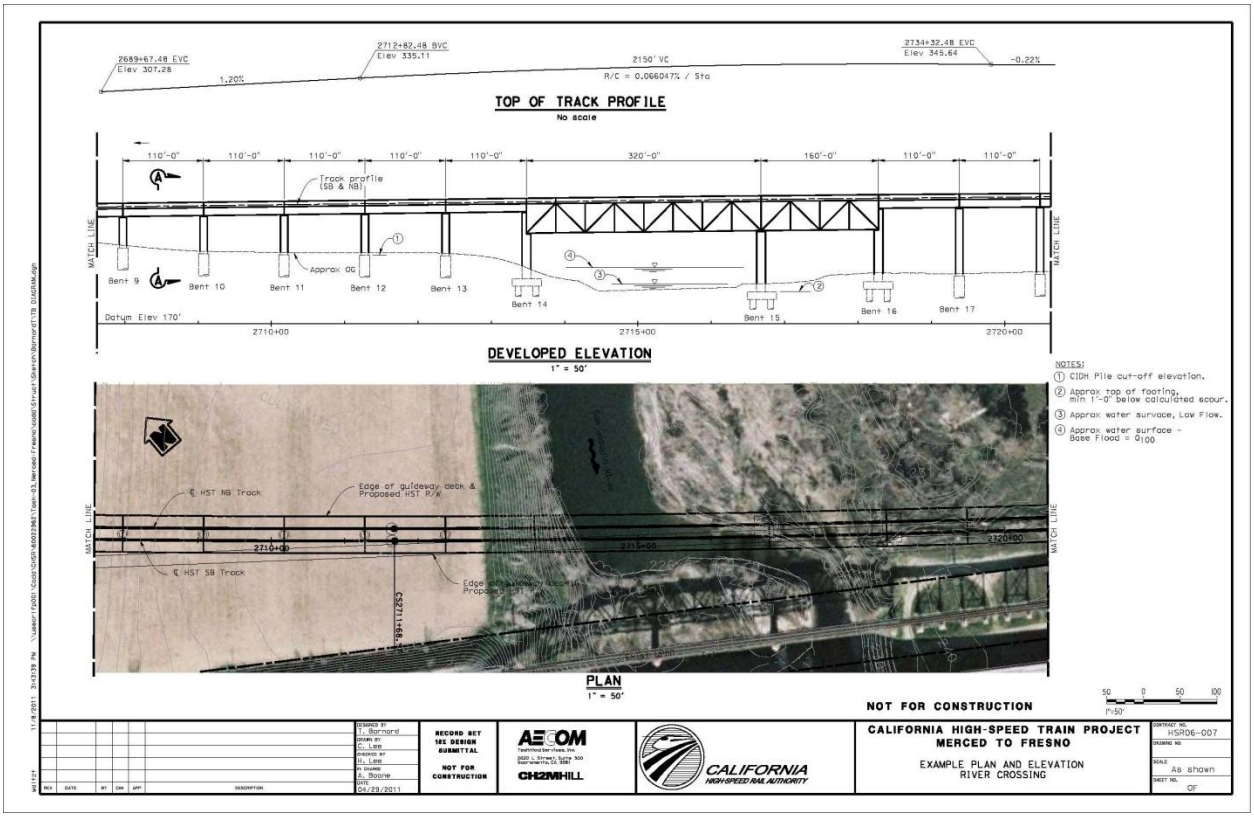

Figure 1. A cross-section and topographic view of pier placements across the San Joaquin River

Additionally periodic maintenance of the piers will need to be done. The typical periodic underwater inspections of bridge foundations are performed on a 60 month cycle. They are usually performed by the owners engineering inspection personnel that have the appropriate certifications for diving in the water depths involved. Owners like the HSRA may hire outside consultants with the appropriate qualifications to perform these tasks.

During construction a qualified fisheries biologist with experience in snorkel surveys and salmonid identification will be conducting fish presence surveys immediately prior to any in-water work (*e.g.*, installation of temporary sheet piles to isolate work area) and surveys will be conducted again if there is a multi-day pause or lapse in construction activities.

It will take approximately two seasons of near-water or at times in-water work (depending on flow) and an additional two seasons of construction for upland piers and bridge deck, for a total of four seasons of bridge work. The proposed HST project is expected to begin in fall of 2013 with the first season of in-stream work occurring in summer of 2014.

B. Action Area

Action area is defined as areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). For purposes of this consultation, the action area consists of two components. The *terrestrial* component of the action area is defined by: 1) the project footprint, including all cleared areas, and staging areas; and 2) construction noise levels in excess of ambient conditions. The *aquatic* component of the

action area is defined by: (1) the segment of the San Joaquin River 400 feet upstream and downstream of bridge construction sites where pile driving sound noise levels are expected to exceed ambient conditions; (2) construction-related water quality impacts in excess of ambient conditions; and (3) operational storm water quality impacts in excess of ambient conditions.

The proposed HST bridge is located just north of the city of Fresno, California at a latitude of 36°50'38.14"N and a longitude of 119°55'56.92"W. The HST guideway would be elevated from approximately 1,000 to 1,500 feet north of the north bank of the San Joaquin River to just north of Veterans Boulevard (in Fresno), a distance of between 9,000 and 12,000 feet. The project area has two distinct environmental settings. The first setting is where the new bridge will be located, which is within the confines of the San Joaquin river channel. The second environmental setting is outside the river channel and includes mostly agricultural type lands.

The topography in the project area ranges from 160 feet near downtown Merced to 300 feet north of downtown Fresno. The topography is mainly flat with slopes ranging from 0 to 2 percent. The Mediterranean climate of the San Joaquin Valley is characterized by hot, dry summers, and cool, wet winters.

Landform groups are a mixture of recent alluvial fans and floodplains, older, low alluvial terraces, basin areas (including saline-alkali basins), high terrace, and hydric soils.
The action area lies in the southern portion of the San Joaquin River Basin. The basin encompasses about 13,500 square miles and includes large areas of high elevation along the western slope of the Sierra Nevada. As a result the San Joaquin River experiences significant snowmelt runoff during the late spring and early summer. Flood flows typically occur between April and June.

The Merced to Fresno section is located in three watershed sub basins: the Middle San Joaquin-Lower Chowchilla, Fresno River, and Upper Dry. Most of the action area is located to the north of the San Joaquin River in the middle San Joaquin –Lower Chowchilla Watershed (Hydrologic Unit Code 18040001). The action area to the south of the San Joaquin River is located in the Tulare-Buena Vista Lakes Watershed (Hydrologic Unit Code 18030012). Prominent water features in the action area include Bear Creek, Miles Creek, Owens Creek, Duck Slough, Deadman Creek, Dutchman Creek, the Chowchilla River, Ash Slough, Brenda Slough, Brenda Creek, the Fresno River, Cottonwood Creek, and the San Joaquin River. The natural hydrology of the region has been substantially altered by the construction of dams, storage reservoirs, diversion dams, canals, and groundwater pumping associated primarily with agricultural irrigation.

C. Proposed Conservation Measures

The following conservation measures have been incorporated into the project design by the FRA/HSRA to avoid and/or minimize potential adverse effects of the proposed HSR project on special status fish species.

1. There will be a construction work window of June 15 – October 15. This time period will minimize impacts on migrating juvenile and adult CCV steelhead and CV spring-run Chinook salmon.

2. Pre-construction fish surveys (snorkel surveys following CDFG Salmonid Restoration Manual techniques) conducted by qualified fisheries biologist to determine the presence and/or density of salmonids utilizing the Resource Study Area (RSA).

3. Contractor education and environmental training about salmonid biology (life history and habitat requirements) and using best management practices (BMPs) as described below to minimize potential impacts on water quality and/or fish habitat.

4. Biological monitoring during construction activities.

5. Use of environmentally sensitive areas and environmentally restricted areas to protect Essential Fish Habitat.

6. Restoration of temporarily disturbed areas upon project completion.

7. Temporary construction sites, including staging areas, lay down and storage areas for equipment, materials, and construction vehicles, parking areas, and incidental stockpiling areas, will be assigned, as feasible, on the north side of the San Joaquin River in areas that do not include sensitive habitat for listed species or that affect riparian vegetation. These temporary construction sites may include areas that are within agriculture, pasture, barren or otherwise disturbed vegetation.

8. Work within the area of the designated floodway will be limited to the period from April 15 to October 31 for flood protection issues, unless otherwise authorized by the Central Valley Flood Protection Board.

9. Develop and implement a Storm Water Pollution Prevention Plan (SWPPP). Temporary construction BMPs will be implemented in accordance with the Merced to Fresno section plans and specifications, as well as the approved SWPPP. BMPs may include, but would not be limited to, silt fences, fiber rolls, straw bales, sandbag barriers, check dams, and sediment basins.

10. Pile Driving Underwater Sound Pressure Measures. The following measures will be implemented to avoid and minimize potential adverse effects that could otherwise result from in-water pile-driving activities:

    - The contractor will develop a plan for pile-driving activities in water to minimize impacts on fish and will allow sufficient time in the schedule for coordination with regulatory agencies. Measures will be implemented to minimize underwater sound pressures to levels below thresholds for peak pressure and accumulated sound exposure levels. Threshold levels established by NMFS that will not be exceeded are as follows:

- Peak Pressure = 206 dB
- Accumulated sound exposure levels = 183 dB

- Underwater sound monitoring will be performed during pile-driving activities. A qualified biologist or natural resource specialist will be present during such work to monitor construction activities and compliance with terms and conditions of permits.

- Sheet piling will be driven by vibratory or nonimpact methods (*i.e.* hydraulic) that result in sound pressures below threshold levels to the extent feasible.

- Pile driving will be conducted only during daylight hours and initially will be used at low energy levels and reduced impact frequency. Applied energy and frequency will be gradually increased until necessary full force and frequency are achieved.

11. Implement Fish Rescue Plan Inside Cofferdam. Installation of the cofferdam and dewatering on the site during construction could result in fish stranding. The contractor will develop and implement a fish rescue plan acceptable to the CDFG, USFWS, and NMFS.

    - The contractor will ensure that a qualified fisheries biologist with a current CDFG collection permit conducts the fish rescue and relocation efforts behind the cofferdam. The fish rescue effort will be implemented during the dewatering of the areas behind the cofferdam(s) and involve capture and return of those fish to suitable habitat within the adjacent waterways. The area will first be seined, followed by electrofishing to remove fish that are behind the cofferdam. A fisheries biologist will be on-site during initial pumping (dewatering) to ensure compliance with the plan.

    - The contractor will monitor the progress of dewatering and allow for the fish rescue to occur prior to completely closing the cofferdam and again when water depths reach approximately 2 feet. USFWS, NMFS, and CDFG will be notified at least 48 hours prior to the start of fish rescue efforts. Information on the species, number, and sizes of fish collected would be recorded during the fish rescue and provided in a letter report to be submitted within 30 days after the fish rescue to USFWS, NMFS, and CDFG.

    - The Fish Rescue Plan will contain methods for minimizing the risk of stress and mortality due to capture and handling of fish removed from the construction site and returned to adjacent waterways.

    - Implementation of the Fish Rescue Plan would minimize potential adverse effects to listed fish species (if present) associated with fish stranding during dewatering activities related to the construction activities.

- The Design-Build team will work systematically with NMFS to establish design hydrology and demonstrate minimal hydraulic impacts from design.

- The San Joaquin Bridge crossing will be designed with the planned increase in flow due to the SJRRP and will maintain or effectively minimize any appreciable changes in scour, sediment transport, deposition, or changes in geomorphic process that could alter habitat conditions in a manner that would impede the reestablishment of CV spring-run Chinook salmon.

- The HSRA along with the Design-Build team will present a final San Joaquin Crossing Plan prior to any site preparation or mobilization of work on or near the San Joaquin River. If final design refinements are deemed to be substantial changes from the original product description, ESA section 7 consultation will be reinitiated.

- Use quarry stone, cobblestone, or their equivalent for erosion control along rivers and streams, complemented with native riparian plantings or other natural stabilization alternatives that would restore and maintain a natural riparian corridor, where feasible.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

The following federally listed species evolutionarily significant units (ESU) or distinct population segments (DPS) occur or are proposed to occur in the action area and may be affected by the proposed project:

Central Valley spring-run Chinook salmon ESU (*Oncorhynchus tshawytscha*)
Threatened (August 15, 2011, 76 FR 157)
California Central Valley steelhead DPS (*Oncorhynchus mykiss*)
Threatened (August 15, 2011, 76 FR 157)

A. Species and Critical Habitat Listing Status

In 2011, NMFS completed an updated status review of five salmon ESUs and one DPS of steelhead, including CV spring-run Chinook salmon and California Central Valley Steelhead, and concluded that the species' status should remain as previously listed (June 28, 2005, 70 FR 37160, 2006 71 FR 834). The new listing concludes that CCV steelhead and CV spring-run Chinook salmon will remain listed as threatened.

1. <u>CV spring-run Chinook salmon</u>

NMFS first listed the CV spring-run Chinook salmon ESU as threatened on September 16, 1999 (64 FR 50394). In August 2011, NMFS proposed that CV spring-run Chinook salmon remain listed as threatened (76 FR 157). This proposal was based on the recognition that the ESU continues to face risks from having a limited number of remaining populations (*i.e.*, 3 existing

independent populations from an estimated 17 historical populations), a limited geographic distribution, and potential hybridization with Feather River Hatchery (FRH) spring-run Chinook salmon, which until recently were not included in the ESU and are genetically divergent from other populations in Mill, Deer, and Butte creeks. On August 15, 2011, after reviewing the best available scientific and commercial information, NMFS issued its final decision to retain the status of CV spring-run Chinook salmon as threatened (76 FR 157). Critical habitat was designated for CV spring-run Chinook salmon on September 2, 2005 (70 FR 52488). Designated critical habitat includes approximately 8,935 net miles (mi) of riverine habitat and 470 mi^2 of estuarine habitat (primarily in San Francisco-San Pablo-Suisun Bays) in California (70 FR 52488). The upper San Joaquin River is not designated critical habitat for CV spring-run Chinook salmon at this time.

2. CCV steelhead

CCV steelhead were originally listed as threatened on March 19, 1998 (63 FR 13347). This DPS consists of steelhead populations in the Sacramento and San Joaquin river basins in California's Central Valley. On August 15, 2011, after reviewing the best available scientific and commercial information, NMFS issued its final decision to retain the status of CCV steelhead as threatened (76 FR 157). This decision also included the Coleman National Fish Hatchery and Feather River Hatchery steelhead populations. These populations were previously included in the DPS but were not deemed essential for conservation and thus not part of the listed steelhead population. Critical habitat was designated for CCV steelhead on September 2, 2005 (70 FR 52488). Critical habitat includes the stream channels to the ordinary high water line within designated stream reaches such as those of the American, Feather, and Yuba Rivers, and Deer, Mill, Battle, Antelope, and Clear creeks in the Sacramento River basin; the Calaveras, Mokelumne, Stanislaus, Tuolumne, and Merced rivers in the San Joaquin River basin; and, the Sacramento and San Joaquin Rivers and Delta.

B. Species Life History, Population Dynamics, and Likelihood of Survival and Recovery

1. Chinook salmon

a. *General Life History*

Chinook salmon exhibit two generalized freshwater life history types (Healey 1991). "Stream-type" Chinook salmon, enter freshwater months before spawning and reside in freshwater for a year or more following emergence, whereas "ocean-type" Chinook salmon spawn soon after entering freshwater and migrate to the ocean as fry or parr within their first year. CV spring-run Chinook salmon exhibit a stream-type life history. Adults enter freshwater in the spring, hold over summer, spawn in fall, and the juveniles typically spend a year or more in freshwater before emigrating. Adults enter freshwater in winter or early spring, and delay spawning until spring or early summer (stream-type). Adequate instream flows and cool water temperatures are more critical for the survival of Chinook salmon exhibiting a stream-type life history due to over summering by adults and/or juveniles.

Chinook salmon typically mature between 2 and 6 years of age (Myers *et al.* 1998). Freshwater entry and spawning timing generally are thought to be related to local water temperature and flow regimes. Runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and the actual time of spawning (Myers *et al*. 1998). Both spring-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months. For comparison, fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of the rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991).

During their upstream migration, adult Chinook salmon require stream flows sufficient to provide olfactory and other orientation cues used to locate their natal streams. Adequate stream flows are necessary to allow adult passage to upstream holding habitat. The preferred temperature range for upstream migration is 38 to 56 degrees Fahrenheit (F) (Bell 1991; CDFG 1998). Boles *et al.* (1988) recommends water temperatures below 65 degrees F for adult Chinook salmon migration, and Lindley *et al.* (2004) report that adult migration is blocked when temperatures reach 70 degrees F, and that fish can become stressed as temperatures approach 70 degrees F. Reclamation reports that spring-run Chinook salmon holding in upper watershed locations prefer water temperatures below 60 degrees F; although salmon can tolerate temperatures up to 65 degrees F before they experience an increased susceptibility to disease.

Information on the migration rates of adult Chinook salmon in freshwater is scant and primarily comes from the Columbia River basin where information regarding migration behavior is needed to assess the effects of dams on travel times and passage (Matter and Sandford 2003). Keefer et al. (2004) found migration rates of Chinook salmon ranging from approximately 10 kilometers (km) per day to greater than 35 km per day and to be primarily correlated with date, and secondarily with discharge, year, and reach, in the Columbia River basin. Matter and Sanford (2003) documented migration rates of adult Chinook salmon ranging from 29 to 32 km per day in the Snake River. Adult Chinook salmon inserted with sonic tags and tracked throughout the Delta and lower Sacramento and San Joaquin rivers were observed exhibiting substantial upstream and downstream movement in a random fashion while on their upstream migration (California Bay-Delta Authority (CALFED) 2001). Adult salmonids migrating upstream are assumed to make greater use of pool and mid-channel habitat than channel margins (Stillwater Sciences 2004), particularly larger salmon such as Chinook salmon, as described by Hughes (2004). Adults are thought to exhibit crepuscular behavior during their upstream migrations; meaning that they primarily are active during twilight hours. Recent hydro-acoustic monitoring showed peak upstream movement of adult CV spring-run Chinook salmon in lower Mill Creek, a tributary to the Sacramento River, occurring in the 4-hour period before sunrise and again after sunset.

Spawning Chinook salmon require clean, loose gravel in swift, relatively shallow riffles or along the margins of deeper runs, and suitable water temperatures, depths, and velocities for redd construction and adequate oxygenation of incubating eggs. Chinook salmon spawning typically occurs in gravel beds that are located at the tails of holding pools (USFWS 1995). The range of water depths and velocities in spawning beds that Chinook salmon find acceptable is very broad.

The upper preferred water temperature for spawning Chinook salmon is 55 to 57 degrees F (Chambers 1956; Smith 1973; Bjornn and Reiser 1991; Snider 2001).

During the four to six week period when alevins remain in the gravel, they utilize their yolk-sac to nourish their bodies. As their yolk-sac is depleted, fry begin to emerge from the gravel to begin exogenous feeding in their natal stream. The post-emergent fry disperse to the margins of their natal stream, seeking out shallow waters with slower currents, finer sediments, and bank cover such as overhanging and submerged vegetation, root wads, and fallen woody debris, and begin feeding on zooplankton, small insects, and other micro-crustaceans. As they switch from endogenous nourishment to exogenous feeding, the fry's yolk-sac is reabsorbed, and the belly suture closes over the former location of the yolk-sac (button-up fry). Fry typically range from 25 mm to 40 mm during this stage. Some fry may take up residence in their natal stream for several weeks to a year or more, while others actively migrate, or are displaced downstream by the streams' current. Once started downstream, fry may continue downstream to the estuary and rear, or may take up residence in river reaches along the way for a period of time ranging from weeks to a year (Healey 1991).

Rearing fry seek near shore habitats containing beneficial aspects such as riparian vegetation and associated substrates important for providing aquatic and terrestrial invertebrates, predator avoidance, and slower velocities for resting (NMFS 1996a). The benefits of shallow water habitats for salmonid rearing also have recently been realized as shallow water habitat has been found to be more productive than the main river channels, supporting higher growth rates, partially due to higher prey consumption rates, as well as favorable environmental temperatures (Sommer *et al*. 2001).

When juvenile Chinook salmon reach a length of 50 to 57 mm, they move into deeper water with higher current velocities, but still seek shelter and velocity refugia to minimize energy expenditures. In the mainstems of larger rivers, juveniles tend to migrate along the margins and avoid the elevated water velocities found in the thalweg of the channel. When the channel of the river is greater than 9 to 10 feet in depth, juvenile salmon tend to inhabit the surface waters (Healey 1982). Migrational cues, such as increasing turbidity from runoff, increased flows, changes in day length, or intraspecific competition from other fish in their natal streams may spur outmigration of juveniles when they have reached the appropriate stage of maturation (Kjelson *et al.* 1982; Brandes and McLain 2001).

Similar to adult movement, juvenile salmonid downstream movement is primarily crepuscular. Martin *et al.* (2001) found that the daily migration of juveniles passing Red Bluff Diversion Dam (RBDD) is highest in the four hour period prior to sunrise. Juvenile Chinook salmon migration rates vary considerably presumably depending on the physiological stage of the juvenile and hydrologic conditions. Kjelson *et al.* (1982) found Chinook salmon fry travel as fast as 30 km per day in the Sacramento River and Sommer *et al.* (2001) found rates ranging from approximately 0.5 miles up to more than six miles per day in the Yolo Bypass. As Chinook salmon begin the smoltification stage, they prefer to rear further downstream where ambient salinity is up to 1.5 to 2.5 parts per thousand (Healey 1980; Levy and Northcote 1981).

Fry and parr may rear within riverine or estuarine habitats of the Sacramento River, the Delta, and their tributaries. In addition, Central Valley Chinook salmon juveniles have been observed rearing in the lower reaches of non-natal tributaries and intermittent streams in the Sacramento Valley during the winter months (Maslin *et al.* 1997; Snider 2001). Within the Delta, juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels, and sloughs (McDonald 1960; Dunford 1975). Cladocerans, copepods, amphipods, and larvae of diptera, as well as small arachnids and ants are common prey items (Kjelson *et al.* 1982; Sommer *et al.* 2001; MacFarlane and Norton 2002). Shallow water habitats are more productive than the main river channels, supporting higher growth rates, partially due to higher prey consumption rates, as well as favorable environmental temperatures (Sommer *et al.* 2001). Optimal water temperatures for the growth of juvenile Chinook salmon in the Delta are between 54 to 57 degrees F (Brett 1952). In Suisun and San Pablo Bays water temperatures reach 54 degrees F by February in a typical year. Other portions of the Delta (*i.e.*, South Delta and Central Delta) can reach 70 degrees F by February in a dry year. However, cooler temperatures are usually the norm until after the spring runoff has ended.

Within the estuarine habitat, juvenile Chinook salmon movements are dictated by the tidal cycles, following the rising tide into shallow water habitats from the deeper main channels, and returning to the main channels when the tide recedes (Levy and Northcote 1982; Levings 1982; Levings *et al.* 1986; Healey 1991). As juvenile Chinook salmon increase in length, they tend to school in the surface waters of the main and secondary channels and sloughs, following the tides into shallow water habitats to feed (Allen and Hassler 1986). In Suisun Marsh, Moyle *et al.* (1989) reported that Chinook salmon fry tend to remain close to the banks and vegetation, near protective cover, and in dead-end tidal channels. Kjelson *et al.* (1982) reported that juvenile Chinook salmon demonstrated a diel migration pattern, orienting themselves to near shore cover and structure during the day, but moving into more open, offshore waters at night. The fish also distributed themselves vertically in relation to ambient light. During the night, juveniles were distributed randomly in the water column, but would school up during the day into the upper three meters of the water column. Available data indicate that juvenile Chinook salmon use Suisun Marsh extensively both as a migratory pathway and rearing area as they move downstream to the Pacific Ocean. Juvenile Chinook salmon were found to spend about 40 days migrating through the Delta to the mouth of San Francisco Bay and grew little in length or weight until they reached the Gulf of the Farallones (MacFarlane and Norton 2002). Based on the mainly ocean-type life history observed (*i.e.*, fall-run Chinook salmon) MacFarlane and Norton (2002) concluded that unlike other salmonid populations in the Pacific Northwest, Central Valley Chinook salmon show little estuarine dependence and may benefit from expedited ocean entry.

b. *CV spring-run Chinook salmon*

Historically the spring-run Chinook salmon were the second most abundant salmon run in the Central Valley (CDFG 1998). These fish occupied the upper and middle reaches (1,000 to 6,000 feet) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults (Stone 1874, Rutter 1904, Clark 1929). The Central Valley Technical Review Team (CVTRT) estimated that historically there were 18 or 19 independent populations of Central Valley spring-

run Chinook salmon, along with a number of dependent populations and four diversity groups (Lindley *et al.* 2004). Of these 18 populations, only three extant populations currently exist (Mill, Deer, and Butte creeks on the upper Sacramento River) and they represent only the Northern Sierra Nevada Diversity group. All populations in the Basalt and Porous Lava group and the Southern Sierra Nevada Diversity Group have been extirpated. The range of the Southern Sierra Nevada Diversity Group includes the San Joaquin River and tributary streams including the Merced, Tuolumne, Stanislaus, Calaveras, and Mokelumne rivers.

The Central Valley drainage as a whole is estimated to have supported spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (CDFG 1998). The spring run was most abundant in the San Joaquin system, ascending and occupying the high-elevation streams fed by snow-melt where they over-summered until the fall spawning season (Yoshiyama *et al*. 1996). Historically the Kings River flowed into the northeast part of Tulare Lake, and its waters occasionally ran into the San Joaquin River during wet periods when water levels became high enough in Tulare Lake to overflow and connect the two drainages. Stream flows would have been greatest during the spring snow-melt period, so it is most likely that the spring run was the predominant or, perhaps, the only run to occur there. In the San Joaquin River the spring run historically ascended the river past the present site of Kerckhoff Power House in the Sierra foothills to spawning grounds in the higher reaches (Yoshiyama *et al.* 1996). The Friant Division of the Central Valley Project consists of Friant Dam, constructed at Millerton, with two significant canals, the Friant-Kern and the Madera canals, which were intended to divert all flows, except flood level flows, of the San Joaquin River in to these canals for delivery to rich farmlands of the San Joaquin Valley. Friant Dam was constructed by 1945, Before the construction of Friant Dam, and nearly 50,000 adults were counted in the San Joaquin River alone (Fry 1961). Completion and operation of the canals of the Friant Division resulted in the San Joaquin River running dry in many locations with the concomitant extirpation of the San Joaquin River salmon runs below Friant Dam. Construction of other low elevation dams in the foothills of the Sierras on the American, Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers extirpated Central Valley spring-run Chinook salmon from these watersheds. Naturally-spawning populations of Central Valley spring-run Chinook salmon currently are restricted to accessible reaches of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and Yuba River (CDFG 1998). Table 1 shows when these abundances occur in their associated watersheds.

Table 1. The temporal occurrence of adult (a) and juvenile (b) Central Valley spring-run Chinook salmon in the Sacramento River. Darker shades indicate months of greatest relative abundance.

(a) Adult

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[1,2]Sac.River basin												
[3]Sac. River												
[4]Mill Creek												
[4]Deer Creek												
[4]Butte Creek												

(b) Juvenile

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[5]Sac. River Tribs												
[6]Upper Butte Creek												
[4]Mill, Deer, Butte Creeks												
[3]Sac. River at RBDD												
[7]Sac. River at Knights Landing (KL)												

Source: Yoshiyama *et al*. 1998; Moyle 2002; Myers *et al*. 1998; Lindley *et al*. 2007; CDFG 1998; McReynolds *et al*. 2005; Ward *et al*. 2002, 2003; Snider and Titus 2000

Relative Abundance: = High = Medium = Low

Adult Central Valley spring-run Chinook salmon leave the ocean to begin their upstream migration in late January and early February (CDFG 1998) and enter the Sacramento River between March and September, primarily in May and June (see Table 6 in text; Yoshiyama *et al.* 1998, Moyle 2002). Lindley *et al.* (2007) indicates adult Central Valley spring-run Chinook salmon enter native tributaries from the Sacramento River primarily between mid-April and mid-June. Typically, spring-run Chinook salmon utilize mid- to high-elevation streams that provide appropriate temperatures and sufficient flow, cover, and pool depth to allow over-summering while conserving energy and allowing their gonadal tissue to mature (Yoshiyama *et al.* 1998).

Spring-run Chinook salmon spawning occurs between September and October depending on water temperatures. Between 56 and 87 percent of adult spring-run Chinook salmon that enter the Sacramento River basin to spawn are 3 years old (Calkins *et al.* 1940; Fisher 1994). Spring-run Chinook salmon fry emerge from the gravel from November to March (Moyle 2002) and the

emigration timing is highly variable, as they may migrate downstream as young-of-the-year or as juveniles or yearlings. The modal size of fry migrants at approximately 40 mm between December and April in Mill, Butte, and Deer creeks reflects a prolonged emergence of fry from the gravel (Lindley *et al.* 2007). Studies in Butte Creek (Ward *et al.* 2002, 2003, McReynolds *et al.* 2005) found the majority of Central Valley spring-run Chinook salmon migrants to be fry occurring primarily during December, January, and February; and that these movements appeared to be influenced by flow. Small numbers of Central Valley spring-run Chinook salmon remained in Butte Creek to rear and migrated as yearlings later in the spring. Juvenile emigration patterns in Mill and Deer creeks are very similar to patterns observed in Butte Creek, with the exception that Mill and Deer creek juveniles typically exhibit a later young-of-the-year migration and an earlier yearling migration (Lindley *et al.* 2007).

Once juveniles emerge from the gravel they initially seek areas of shallow water and low velocities while they finish absorbing the yolk sac and transition to exogenous feeding (Moyle 2002). Many also will disperse downstream during high-flow events. As is the case in other salmonids, there is a shift in microhabitat use by juveniles to deeper faster water as they grow larger. Microhabitat use can be influenced by the presence of predators which can force fish to select areas of heavy cover and suppress foraging in open areas (Moyle 2002). The emigration period for spring-run Chinook salmon extends from November to early May, with up to 69 percent of the young-of-the-year fish outmigrating through the lower Sacramento River and Delta during this period (CDFG 1998). Peak movement of juvenile Central Valley spring-run Chinook salmon in the Sacramento River at Knights Landing occurs in December, and again in March and April. However, juveniles also are observed between November and the end of May (Snider and Titus 2000). Based on the available information, the emigration timing of Central Valley spring-run Chinook salmon appears highly variable (CDFG 1998). Some fish may begin emigrating soon after emergence from the gravel, whereas others over-summer and emigrate as yearlings with the onset of intense fall storms (CDFG 1998).

The spring-run Chinook salmon populations that formerly occurred in the basalt and porous-lava region and southern Sierra Nevada region have been extirpated. The northwestern California region contains a few ephemeral populations (*e.g.*, Clear, Cottonwood, and Thomes creeks) of spring-run Chinook salmon that are likely dependent on the Northern Sierra populations for their continued existence. Over the long term, these remaining populations are considered to be vulnerable to catastrophic events, such as volcanic eruptions from Mount Lassen or large forest fires due to the close proximity of their headwaters to each other. Drought is also considered to pose a significant threat to the viability of the spring-run Chinook salmon populations in these three watersheds due to their close proximity to each other. One large event could eliminate all three populations. Figure 2 shows spring-run escapement for the Sacramento watershed through February 2011.

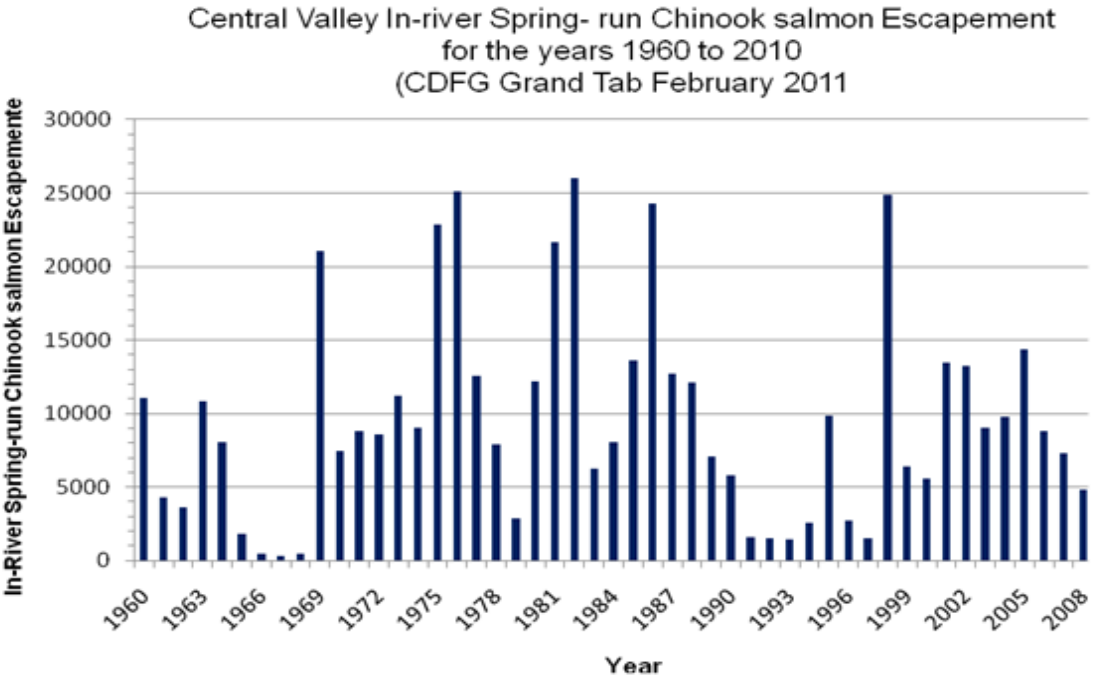

Figure 2: Annual estimated Central Valley in-river spring-run Chinook salmon escapement population for the Sacramento River watershed for years 1960 through 2010 (CDFG Grand Tab 2011).

Recent status reviews by NMFS Southwest Fisheries Science Center (SWFSC) and Central Valley Office have led to the following discernments. The spring-run ESU boundary has not changed. This review and analysis concluded that the Feather River hatchery stock of spring run Chinook was substantially divergent from other natural stocks in the Central Valley (Butte, Deer and Mill creeks) as a result of introgression with fall-run Chinook salmon at the hatchery. Nevertheless, NMFS ultimately concluded this hatchery stock should be included in the ESU because it still exhibited spring-run migration timing and was the best opportunity for restoring a more natural spring-run population in the Feather River. Overall escapements have declined over the past 10 years, in particular since 2006. At the ESU level, the reestablishment of spring-run Chinook salmon into Battle Creek (persisting since around 1995) and the increasing abundance of spring-run Chinook salmon in Clear Creek are improving the status of CV spring-run Chinook salmon. Further efforts will need to involve more than restoration of currently accessible watersheds. The draft Central Valley Recovery Plan calls for reestablishing populations into historical habitats currently blocked by large dams, such as those underway to establish spring-run Chinook salmon production in the San Joaquin River below Friant Dam, a population above Shasta Dam, and to facilitate passage of fish above Englebright Dam on the Yuba River will be needed to make the ESU viable. New information available since Good *et al.* (2005) indicates an increased extinction risk for the ESU (Williams *et al.* 2011). The available information indicates that fishery impacts on the CV spring-run Chinook salmon ESU have not changed appreciably since the 2005 status review (Good *et al.* 2005), except that impacts were extremely low to non-existent in 2008 and 2009. Climate change is expected to exacerbate existing stressors and pose new threats to Central Valley salmonids, including the CV spring-run Chinook, by reducing the quantity and quality of inland habitat (Lindley *et al.* 2007). The poor

ocean conditions in recent years clearly have had adverse impacts on the CV spring-run Chinook ESU. With a few exceptions, CV spring-run Chinook salmon populations have declined over the past 10 years particularly since 2006. Overall, the NMFS SWFSC concluded in their viability report that the status of CV spring-run Chinook salmon ESU has probably deteriorated since the 2005 status review and that its extinction risk has increased (Williams *et al.* 2011). The status of this ESU has worsened since the last review, and therefore, we recommend that its status be reassessed in 2-3 years if it does not respond positively to improvements in environmental conditions and management actions.

(1) Population Dynamics. The CV spring-run Chinook salmon ESU has displayed broad fluctuations in adult abundance, ranging from 1,403 in 1993 to 25,890 in 1982. The genetic integrity of Feather River spring-run Chinook salmon is questionable because of the significant temporal and spatial overlap between spawning populations of spring-run and fall-run Chinook salmon (Good *et al.* 2005). For the reasons discussed above, the Feather River spring-run Chinook population numbers are not included in the following discussion of ESU abundance. The average abundance for the ESU was 12,590 for the period of 1969 to 1979, 13,334 for the period of 1980 to 1990, 6,554 from 1991 to 2001, and 16,349 between 2002 and 2005. For the period of 2006 to 2008 the average abundance for the ESU fell to a low of 854 (CDFG 2009). Sacramento River tributary populations in Mill, Deer, and Butte creeks are probably the best trend indicators for the CV spring-run Chinook ESU as a whole because these streams contain the primary independent populations within the ESU. Generally, these streams have shown a positive escapement trend since 1991 until recently. Escapement numbers are dominated by Butte Creek returns, which have averaged over 7,000 fish since 1995 (until 2005). During this same period, adult returns on Mill Creek have averaged 778 fish, and 1,463 fish on Deer Creek. Although recent trends had been positive, annual abundance estimates display a high level of fluctuation, and the overall number of CV spring-run Chinook salmon remains well below estimates of historic abundance. Additionally, in 2003 high water temperatures, high fish densities, and an outbreak of Columnaris Disease (*Flexibacter Columnaris*) and Ichthyophthiriasis (*Ichthyophthirius multifiis)* contributed to the pre-spawning mortality of an estimated 11,231 adult spring-run Chinook salmon in Butte Creek. Most recently from 2007 to 2011 most spring-run Chinook salmon population numbers have shown a steady decrease, resulting in the tributary population's 5-year average being 3,961, the lowest since before 1998.

(2) Viable Salmonid Population Summary for Central Valley spring-run Chinook Salmon. The following summary has been compiled from the best available data and information on CV spring-run Chinook salmon to provide a general synopsis of the viability parameters for this ESU.

Abundance. With a few exceptions, escapements have declined over the past 10 years, in particular since 2006. The recent declines in abundance place the Mill and Deer creek populations in the high extinction risk category due to their rate of decline, and in the case of Deer Creek, also the level of escapement. Butte Creek continues to satisfy the criteria for low extinction risk, although the rate of decline is close to triggering the population decline criterion for high risk. Overall, the recent declines have been significant but not severe enough to qualify as a catastrophe under the criteria of Lindley *et al.* (2007). On the brighter side, spring-run Chinook salmon appear to be repopulating Battle Creek, home to an historical independent

population in the Basalt and Porous Lava Diversity Group that was extirpated for many decades. This population has increased in abundance to levels that would qualify it for a moderate extinction risk score. Similarly, the spring-run Chinook salmon population in Clear Creek has been increasing, although Lindley *et al.* (2004) classified this population as a dependent population, and thus is not expected to exceed the low-risk population size threshold of 2500 fish.

Until recently, we were unaware of any reports of hatchery-origin fish spawning in the higher elevation areas of Butte, Deer or Mill creeks utilized by spring-run Chinook. In 2010, 10 coded-wire tags of Feather River spring Chinook salmon were recovered from a sample of 1,113 carcasses in the upper reached of Butte Creek (T. McReynolds, CDFG, pers. comm., 15 December 2010). As 100 percent of FRH spring Chinook salmon production is marked and tagged, this translates into slightly less than 1 percent of the Butte Creek returns being comprised of hatchery strays. This is well below the 10 percent allowable stray rate for out-of-diversity-group-origin fish within one generation. Prolonged influx of 46 FRH strays at even this low level is undesirable, as it would cause the receiving population to shift to a moderate risk level after four generations of such impact. The CV spring-run Chinook salmon ESU has experienced a trend of increasing abundance in some natural populations, most dramatically in the Butte Creek population (Good *et al.* 2005). There has been more opportunistic utilization of migration-dependent streams overall. The FRH spring-run stock has been included in the ESU based on its genetic linkage to the natural population and the potential development of a conservation strategy for the hatchery program.

Productivity. The 5-year geometric mean for the extant Butte, Deer, and Mill creek spring-run populations ranges from 491 to 4,513 fish (Good *et al.* 2005), indicating increasing productivity over the short-term and projected as likely to continue (Good *et al.* 2005). The productivity of the Feather River and Yuba River populations and contribution to the CV spring-run ESU currently is unknown.

Spatial Structure. Spring-run Chinook salmon presence has been reported more frequently in several upper Central Valley creeks, but the sustainability of these runs is unknown. Butte Creek spring-run cohorts have recently utilized all available habitat in the creek; the population cannot expand further and it is unknown if individuals have opportunistically migrated to other systems. The spatial structure of the spring-run ESU has been seriously compromised by the extirpation of all San Joaquin River basin spring-run populations.

Diversity. The CV spring-run ESU fails to meet the "representation and redundancy rule," since the Northern Sierra Nevada is the only diversity group in the spring-run ESU that contains demonstrably viable populations out of at least 3 diversity groups that historically contained them. Independent populations of spring-run only occur within the Northern Sierra Nevada diversity group. The Northwestern California Diversity Group contains a few ephemeral populations of spring-run that are likely currently dependent on the Northern Sierra Nevada populations for their continued existence. The spring-run populations that historically occurred in the Basalt and Porous Lava, and Southern Sierra Nevada diversity groups have been extirpated, although a small population in Battle Creek has been reestablished and persisting over the last 15 years. Over the long term, the three remaining independent populations are

considered to be vulnerable to catastrophic events, such as volcanic eruptions from Mount Lassen or large forest fires due to the close proximity of their headwaters to each other. Drought is also considered to pose a significant threat to the viability of the spring-run populations in the Deer, Mill and Butte Creek watersheds due to their close proximity to each other. Feather River spring-run have introgressed with the fall-run, and it appears that the Yuba River population may have been impacted by FRH fish straying into the Yuba River. Additionally, the diversity of the spring-run ESU has been further reduced with the loss of the San Joaquin River basin spring-run populations. Overall, CV spring-run Chinook salmon extinction risk has increased (Williams *et al.* 2011).

2. CCV steelhead

a. *General Life History*

Steelhead can be divided into two life history types, summer-run steelhead and winter-run steelhead, based on their state of sexual maturity at the time of river entry and the duration of their spawning migration, stream-maturing and ocean-maturing. Only winter-run (ocean maturing) steelhead currently are found in California Central Valley rivers and streams (Moyle 2002; McEwan and Jackson 1996). Summer-run steelhead has been extirpated due to a lack of suitable holding and staging habitat, such as cold water pools in the headwaters of CV streams, presently located above impassible dams (Lindley *et al.* 2006).

CCV steelhead remain in the ocean for up to four years before returning to their natal streams as adults to spawn (Shapovalov and Taft 1954). Adult steelhead size depends on the length of their ocean residency (Meehan and Bjornn 1991). Unlike Pacific salmon, steelhead do not appear to form schools in the ocean (Behnke 1992). Steelhead in the southern part of their range appear to migrate close to the continental shelf, while more northern populations may migrate throughout the northern Pacific Ocean (Barnhart 1991). CCV steelhead generally leave the ocean from August through April (Busby *et al.* 1996) and enter freshwater from August to November and spawn from December to April, with peaks from January through March, in small streams and tributaries where cool, well oxygenated water is available year-round (Williams 2006; Hallock *et al.* 1961; McEwan and Jackson 1996). CCV Steelhead hold over in pools while maturing sexually, while others begin sexual maturation in the ocean and spawn within a few months after entering streams (Williams 2006). Timing of upstream migration is correlated with higher flow events, such as freshets or sand bar breaches, and associated lower water temperatures. The minimum stream depth necessary for successful upstream migration is 13 cm (Thompson 1972). Table 2 show the various migration and holding periods for CCV steelhead in various central valley watersheds.

Adults typically spend a few months in freshwater before spawning (Williams 2006). Female steelhead construct redds in suitable gravels, primarily in pool tailouts and heads of riffles. Steelhead generally return to freshwater at ages 2 and 3 and range in size from 2 to 12 pounds (Reynolds *et al*. 1993). The number of eggs laid per female depends on size and origin of the fish (Moyle 2002). Steelhead about 55 cm long may have fewer than 2000 eggs, whereas steelhead 85 cm long can have 5,000 to 10,000 eggs, depending on the stock (Meehan and Bjornn 1991).

Table 2. The temporal occurrence of adult (a) and juvenile (b) Central Valley steelhead in the Central Valley. Darker shades indicate months of greatest relative abundance.
Sources: Hallock 1961; McEwan 2001; USFWS unpublished data; CDFG 1995; Hallock *et al*. 1957; Bailey 1954; CDFG Steelhead Report Card Data; CDFG unpublished data; Snider and Titus 2000; Nobriga and Cadrett 2003; Jones & Stokes Associates, Inc., 2002; S.P. Cramer and Associates, Inc. 2000 and 2001; Schaffter 1980, 1997.

(a) Adult migration/holding

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[1,3]Sac. River												
[2,3]Sac R at Red Bluff												
[4]Mill, Deer Creeks												
[6]Sac R. at Fremont Weir												
[6]Sac R. at Fremont Weir												
[7]San Joaquin River												

(b) Juvenile migration

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
[1,2]Sacramento River												
[2,8]Sac. River @ KL												
[9]Sac. River @ KL												
[10]Chipps Island (wild)												
[8]Mossdale												
[11]Woodbridge Dam												
[12]Stan R. at Caswell												
[13]Sac R. at Hood												

Relative Abundance: = High = Medium = Low

Unlike Pacific salmon, steelhead are iteroparous, which are capable of spawning more than once before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Busby *et al.* 1996). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996). Although one-time spawners are the great majority, Shapolov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in California streams. Hatchery steelhead are typically less likely than wild fish to survive to spawn a second time (Leider *et al.* 1986). Post-spawning steelhead may migrate downstream to the ocean immediately after spawning or may spend several weeks holding in pools before out migrating (Shapovalov and Taft 1954). Steelhead eggs hatch in three to four weeks at 10 to 15 degrees Celsius (Moyle 2002). The length of time it takes for eggs to hatch depends mostly on water temperature. After hatching, alevins remain in the gravel for an additional two to five weeks while absorbing their yolk sacs, and emerge in spring or early summer (Barnhart 1991). Fry emerge from the gravel usually about four to six weeks after hatching, but factors such as redd depth, gravel size, siltation, and temperature can speed or retard this time (Shapovalov and Taft 1954). Upon emergence, fry inhale air at the stream surface to fill their air bladders, absorb the remains of their yolks, and start to feed actively, often in schools (Barnhart 1991; NMFS 1996a). Then the newly emerged fry move to the shallow, protected areas associated within the stream margin (McEwan and

Jackson 1996) and they soon move to other areas of the stream and establish feeding locations, which they defend (Shapovalov and Taft 1954). Fry are typically less than 50 millimeters standard length (SL) (Moyle 2002). As fry increase in size and their swimming abilities improve during late summer and fall, they increasingly use areas with cover and exhibit a preference for higher velocity, deeper mid-channel areas near the thalweg (Hartman 1965; Everest and Chapman 1972; Fontaine 1988). Optimal water temperatures for growth range from 15 to18 degrees Celsius (Moyle 2002).

Juvenile steelhead (parr) rear in freshwater for one to three years before outmigrating to the ocean as smolts (Moyle 2002). The time that parr spend in freshwater appears to be related to growth rate, with larger, faster-growing members of a cohort smolting earlier (Peven *et al.* 1994). Juveniles occupy a wide range of habitats, preferring deep pools, as well as higher velocity rapid and cascade habitats (Bisson *et al.* 1982, 1988). During periods of low temperatures (< 44.6 degrees F) and high flows associated with the winter months, juvenile steelhead seek refuge in interstitial spaces in cobble and boulder substrates (Bustard and Narver 1975; Everest *et al.* 1986). Juveniles' winter hiding behavior reduces their metabolism and food intake requirements and minimizes their exposure to predation and high flows (Bustard and Narver 1975). Steelhead rearing during the summer takes place primarily in higher velocity areas in pools, although young-of-year also are abundant in glides and riffles. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small woody debris. Cover is an important habitat component for juvenile steelhead both as velocity refugia and as a means of avoiding predation (Meehan and Bjornn 1991).

Steelhead smolts migrate downstream during most months of the year , but the peak period of emigration occurs in spring, with a much smaller peak in the fall (Hallock *et al.* 1961). Emigrating steelhead use the lower reaches of a river and the Delta for rearing and as a migration corridor to the ocean. Juvenile steelhead feed mostly on drifting aquatic organisms and terrestrial insects and will also take active bottom invertebrates (Moyle 2002). Some may utilize tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas for short periods prior to their final emigration to the sea. Hallock *et al.* (1961) found that juvenile steelhead migrate downstream during most months of the year, but the peak period of emigration occurred in the spring with a much smaller peak in the fall. Nobriga and Cadrett (2003) also have verified these temporal findings based on analysis of captures at Chipps Island, Suisun Bay.

Historic CCV steelhead run sizes are difficult to estimate given the paucity of data, but may have approached one to two million adults annually (McEwan 2001). By the early 1960s the steelhead run size had declined to about 40,000 adults (McEwan 2001). About 80 percent of habitat in the Central Valley was historically available to anadromous *O. mykiss* is now behind impassible dams (Lindley *et al.* 2006). The extent of habitat loss for steelhead most likely was much higher than that for salmon because steelhead were undoubtedly more extensively distributed. Due to their superior jumping ability, the timing of their upstream migration which coincided with the winter rainy season, and their less restrictive preferences for spawning gravels, steelhead could have utilized at least hundreds of miles of smaller tributaries not accessible to the earlier-spawning salmon (Yoshiyama *et al*. 1996). Many historical populations of CCV steelhead are entirely above impassable barriers and may persist as resident or adfluvial

rainbow trout, although they are presently not considered part of the DPS. Steelhead were found as far south to the Kings River (and possibly Kern River systems in wet years) (McEwan 2001). Native American groups such as the Chunut people have had accounts of steelhead in the Tulare Basin. A Chunut informant interviewed by Latta (1977) attested to the presence of steelhead in Tulare Lake.

In the Mokelumne River, East Bay Municipal Utilities District (EBMUD) has included steelhead in their redd surveys on the Lower Mokelumne River since the 1999-2000 spawning season. Based on data from these surveys, the overall trend suggests that redd numbers have slightly increased over the years (2000-2010). However, according to Satterthwaite *et al*. (2010), it is likely that most of the *O. mykiss* spawning in the Mokelumne River are non-anadromous (ore resident) fish rather than steelhead. There are monitoring efforts such as rotary screw traps and weirs in the Calaveras, Stanislaus, Tuolumne, and Merced rivers. The data in these monitoring efforts show that steelhead numbers are very small. Although there have been recent restoration efforts in the San Joaquin River tributaries, CCV steelhead populations in the San Joaquin Basin have been generally showing a continuing decline, an overall low abundance, and fluctuating return rates. Lindley *et al*. (2007) developed viability criteria for Central Valley salmonids. Using data through 2005, Lindley *et al*. (2007) found that data were insufficient to determine the status of any of the naturally-spawning populations of California Central Valley steelhead, except for those spawning in rivers adjacent to hatcheries, which were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas.

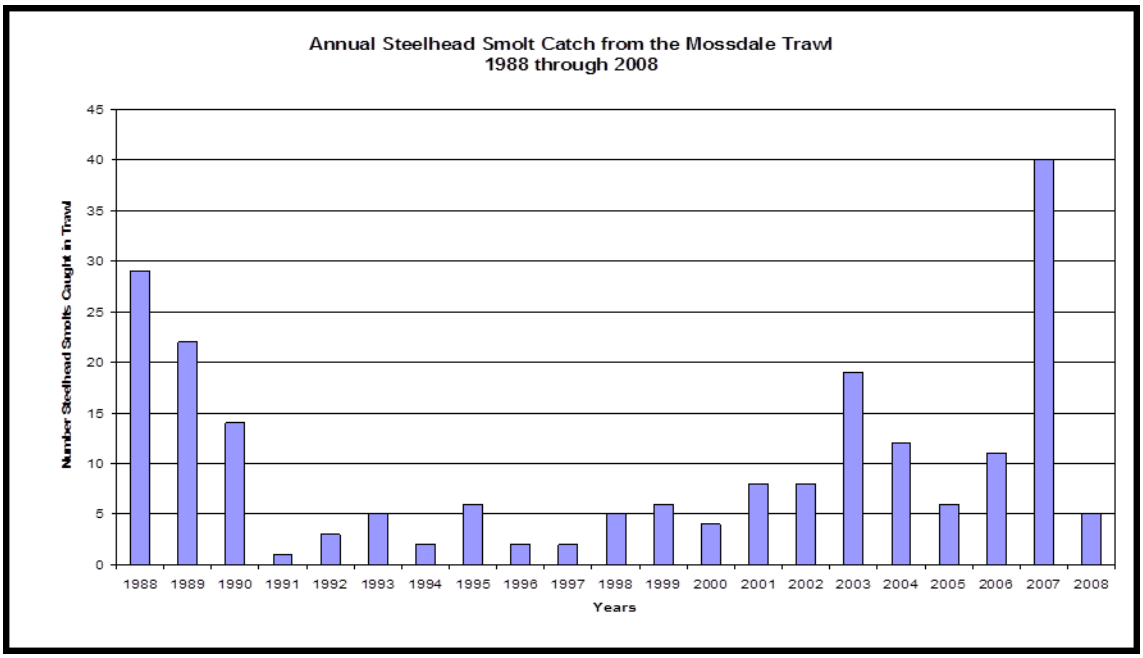

Figure 3: Annual number of California Central Valley steelhead smolts caught while Kodiak trawling at the Mossdale monitoring location on the San Joaquin River (Marston 2004, SJRG 2007, Jonathan Speegle, USFWS 2008, personal communication).

(1) Population Dynamics. Historic CCV steelhead run sizes are difficult to estimate given the paucity of data, but may have approached one to two million adults annually (McEwan 2001).

By the early 1960s the steelhead run size had declined to about 40,000 adults (McEwan 2001). Over the past 30 years, the naturally-spawned steelhead populations in the upper Sacramento River have declined substantially. Hallock *et al.* (1961) estimated an average of 20,540 adult steelhead through the 1960s in the Sacramento River, upstream of the Feather River. Steelhead counts at the RBDD declined from an average of 11,187 for the period of 1967 to 1977, to an average of approximately 2,000 through the early 1990s, with an estimated total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults (McEwan and Jackson 1996; McEwan 2001). Steelhead escapement surveys at RBDD ended in 1993 due to changes in dam operations.

Recent estimates from trawling data in the Delta indicate that approximately 100,000 to 300,000 (mean 200,000) smolts emigrate to the ocean per year, representing approximately 3,600 female steelhead spawners in the Central Valley basin (Good *et al*. 2005). This can be compared with McEwan's (2001) estimate of one million to two million spawners before 1850, and 40,000 spawners in the 1960s.

Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries, including Antelope, Deer, and Mill creeks and the Yuba River. Small populations may exist in Battle Creek, Big Chico and Butte creeks and a few wild steelhead are produced in the American and Feather rivers (McEwan and Jackson 1996). Snorkel surveys since 1999 indicate that steelhead are present in Clear Creek (Giovanetti 2010). Because of the large resident *O. mykiss* population in Clear Creek, steelhead spawner abundance has not been estimated.

Until recently, CCV steelhead were thought to be extirpated from the San Joaquin River system. Recent monitoring has detected small self-sustaining populations of steelhead in the Stanislaus, Mokelumne, and Calaveras rivers, and other streams previously thought to be devoid of steelhead (McEwan 2001). On the Stanislaus River, steelhead smolts have been captured in rotary screw traps at Caswell State Park and Oakdale each year since 1995 (S.P. Cramer and Associates Inc. 2000, 2001). It is possible that naturally-spawning populations exist in many other streams but are undetected due to lack of monitoring programs (IEP Steelhead Project Work Team 1999). Incidental catches and observations of steelhead juveniles also have occurred on the Tuolumne and Merced rivers during fall-run Chinook salmon monitoring activities, indicating that steelhead are widespread throughout accessible streams and rivers in the Central Valley (Good *et al*. 2005). CDFG staff has prepared juvenile migrant CCV steelhead catch summaries on the San Joaquin River near Mossdale representing migrants from the Stanislaus, Tuolumne, and Merced rivers. Based on trawl recoveries at Mossdale between 1988 and 2002, as well as rotary screw trap efforts in all three tributaries, CDFG staff stated that it is “clear from this data that rainbow trout do occur in all the tributaries as migrants and that the vast majority of them occur on the Stanislaus River” (Letter from Dean Marston, CDFG, to Madelyn Martinez, NMFS, January 9, 2003). The documented returns on the order of single fish in these tributaries suggest that existing populations of CCV steelhead on the Tuolumne, Merced, and lower San Joaquin rivers are severely depressed.

Good (2005) indicated that prior population census estimates completed in the 1990s found the CV steelhead spawning population above RBDD had a fairly strong negative population growth

rate and small population size. Good *et al.* (2005) indicated the decline was continuing as evidenced by new information (Chipps Island trawl data). CCV steelhead populations generally show a continuing decline, an overall low abundance, and fluctuating return rates.

(2) Viable Salmonid Population Summary for CCV Steelhead. The following summary has been compiled from the best available data and information on CV steelhead to provide a general synopsis of the viability parameters for this DPS.

Abundance. All indications are that natural California Central Valley steelhead have continued to decrease in abundance and in the proportion of natural fish over the past 25 years (Good *et al*. 2005); the
long-term trend remains negative. There has been little steelhead population monitoring, despite the recent monitoring on the San Joaquin River tributaries. Zimmerman *et al*. (2009) used otolith microchemistry to show that *O. mykiss* of anadromous parentage occur in all three major San Joaquin River tributaries, but at low levels, and that these tributaries have a higher percentage of resident *O. mykiss* compared to the Sacramento River and its tributaries.

Productivity. The Mossdale trawls on the San Joaquin River conducted annually by CDFG and USFWS capture steelhead smolts, although usually in very small numbers. These steelhead recoveries represent migrants from the Stanislaus, Tuolumne, and Merced rivers suggest that existing populations of CCV steelhead on these tributaries are severely depressed. In addition, the Chipps Island midwater trawl dataset from the USFWS provides information on the trend in the overall abundance of the CCV steelhead DPS (Williams *et al*. 2011). Updated through 2010, the trawl data indicate that the apparent decline in natural production of steelhead has continued since the 2005 status review. Catch-per-unit-effort has fluctuated over the past decade, but the proportion of the catch that is ad-clipped (100 percent of all hatchery produced steelhead have been ad-clipped since 1998) has steadily increased, exceeding 90 percent in recent years and reaching 95 percent in 2010 (Williams *et al*. 2011). Because hatchery releases have been fairly constant over the years, these data suggest that natural production of steelhead has been declining.

Spatial Structure. Steelhead have been confirmed in all of the tributaries of the San Joaquin River Basin: Mokelumne, Calaveras, Stanislaus, Tuolumne, and Merced rivers. The efforts to provide passage of salmonids over impassable dams may increase the spatial diversity of California Central Valley steelhead populations if the passage programs are implemented for steelhead. In addition, the San Joaquin River Restoration Program (SJRRP) calls for a combination of channel and structural modifications along the San Joaquin River below Friant Dam, releases of water from Friant Dam to the confluence of the Merced River, and the reintroduction of spring-run Chinook salmon. If the SJRRP is successful, habitat improved for spring-run could also benefit CCV steelhead as well (NMFS 2011).

Diversity. Diversity, both genetic and behavioral, provides a species the opportunity to track environmental changes. CCV steelhead naturally experience the most diverse life history strategies of the listed Central Valley anadromous salmonid species. However, as the species' abundance decreases, and spatial structure of the DPS is reduced, it has less flexibility to track changes in the environment. CCV steelhead abundance and growth rate continue to decline,

largely the result of a significant reduction in the diversity of habitats available to CCV steelhead (Lindley *et al*. 2006). The genetic diversity of CCV steelhead is also compromised by hatchery origin fish (such as the Mokelumne River Hatchery), which likely compromise the majority of the natural spawning run, placing the natural population a high risk of extinction (Lindley *et al*. 2007). Some genetic and behavioral variation is conserved in that in any given year, there are additional cohorts in the marine environment, and therefore, not expose to the same environmental stressors as their freshwater cohorts.

C. Factors Affecting the Species and Critical Habitat

Water development, water quality, over-harvesting, and disease and predation are some of the many issues affecting the decline of listed anadromous fish species in California. Hydropower, flood control, and water supply dams of the Federal Central Valley Project (CVP), State Water Project (SWP), and other municipal and private entities have permanently blocked or hindered salmonid historical spawning and rearing grounds. Clark (1929) estimated that originally there were 6,000 linear miles of salmon habitat in the Central Valley system and that 80 percent of this habitat had been lost by 1928. Yoshiyama *et al*. (1996) calculated that roughly 2,000 linear miles of salmon habitat was actually available before dam construction and mining, and concluded that 82 percent is not accessible today.

As a result of migrational barriers, spring-run Chinook salmon, and steelhead populations have been confined to lower elevation mainstems that historically only were used for migration. Higher temperatures at these lower elevations during late-summer and fall are a major stressor to adult and juvenile salmonids. Thus, population abundances have declined in these streams due to decreased quantity and quality of spawning and rearing habitat.

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the Central Valley. Thousands of small and medium-size water diversions exist along the Sacramento and San Joaquin Rivers, and their tributaries. Although efforts have been made in recent years to screen some of these diversions, many remain unscreened. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile salmonids and green sturgeon. For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001).

Levee development in the Central Valley affects spawning habitat, freshwater rearing habitat, freshwater migration corridors, and estuarine habitat primary constituent elements (PCEs). The construction of levees disrupts the natural processes of the river, resulting in a multitude of habitat-related effects. Many of these levees use angular rock (riprap) to armor the bank from erosion. The effects of channelization, and rip-rapping, include the alteration of river hydraulics and cover along the bank as a result of changes in bank configuration and structural features (Stillwater Sciences 2006). These changes affect the quantity and quality of near-shore habitat for juvenile salmonids and have been thoroughly studied (USFWS 2000; Schmetterling *et al.* 2001; Garland *et al*. 2002). Simple slopes protected with rock revetment generally create near-shore hydraulic conditions characterized by greater depths and faster, more homogeneous water

velocities than occur along natural banks. Higher water velocities typically inhibit deposition and retention of sediment and woody debris. These changes generally reduce the range of habitat condition typically found along natural shorelines, especially by eliminating the shallow, slow-velocity river margins used by juvenile fish as refuge and escape from fast currents, deep water, and predators (Stillwater Sciences 2006).

Increased sedimentation resulting from agricultural and urban practices within the Central Valley is one of the primary causes of salmonid habitat degradation (NMFS 1996a). Sedimentation can adversely affect salmonids during all freshwater life stages by: clogging or abrading gill surfaces, adhering to eggs, hampering fry emergence (Phillips and Campbell 1961), burying eggs or alevins, scouring and filling in pools and riffles, reducing primary productivity and photosynthesis activity (Cordone and Kelley 1961), and affecting intergravel permeability and dissolved oxygen (DO) levels. Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning and egg and fry survival (Waters 1995). In addition, urban storm water and agricultural runoff may be contaminated with pesticides, oil, grease, heavy metals, polycyclic aromatic hydrocarbons (PAHs), and other organics and nutrients (CRWQCB 1998) that can potentially destroy aquatic life necessary for salmonid and green sturgeon survival (NMFS 1996a,b). Point source (PS) and non-point source (NPS) pollution occurs in almost every area where urbanization activity influences the watershed. Impervious surfaces (*i.e.*, concrete, asphalt, and buildings) reduce water infiltration and increase runoff, thus creating greater flood hazard (NMFS 1996a,b). Flood control and land drainage schemes may increase the flood risk downstream by concentrating runoff. A flashy discharge pattern results in increased bank erosion with subsequent loss of riparian vegetation, undercut banks and stream channel widening. In addition to the PS and NPS inputs from urban runoff, juvenile salmonids and green sturgeon are exposed to increased water temperatures as a result of thermal inputs from municipal, industrial, and agricultural discharges.

These human activities have led to increased water temperatures, decreased DO levels, and increased turbidity and contaminant loads have degraded the quality of the aquatic habitat for the rearing and migration of salmonids. Most anthropogenic chemicals and waste materials including toxic organic and inorganic chemicals eventually accumulate in the sediment (Ingersoll 1995). Direct exposure to contaminated sediments may cause deleterious effects to listed salmonids. This may occur if a fish swims through a plume of the re-suspended sediments or rests on contaminated substrate and absorbs the toxic compounds through one of several routes: dermal contact, ingestion, or uptake across the gills. Elevated contaminant levels may be found in localized “hot spots” where discharge occurs or where river currents deposit sediment loads. Sediment contaminant levels can thus be significantly higher than the overlying water column concentrations (Environmental Protection Agency [EPA] 1994). However, the more likely route of exposure to salmonids is through the food chain, when fish feed on organisms that are contaminated with toxic compounds. Prey species become contaminated either by feeding on the detritus associated with the sediments or dwelling in the sediment itself. Therefore, the degree of exposure to the salmonids depends on their trophic level and the amount of contaminated forage base they consume. Response of salmonids to contaminated sediments is similar to water borne exposures.

Extensive ocean recreational and commercial troll fisheries for Chinook salmon exist along the Northern and Central California coast, and an inland recreational fishery exists in the Central Valley for Chinook salmon and steelhead. Ocean harvest of Central Valley Chinook salmon is estimated using an abundance index, called the Central Valley Index (CVI). The CVI is the ratio of Chinook salmon harvested south of Point Arena (where 85 percent of Central Valley Chinook salmon are caught) to escapement (adult spawner populations that have "escaped" the ocean fisheries and made it into the rivers to spawn). CWT returns indicate that Sacramento River salmon congregate off the California coast between Point Arena and Morro Bay.

In-river recreational fisheries historically have taken CV spring-run Chinook salmon throughout the species' range. During the summer, holding adult CV spring-run Chinook salmon are easily targeted by anglers when they congregate in large pools. Poaching also occurs at fish ladders, and other areas where adults congregate; however, the significance of poaching on the adult population is unknown. Specific regulations for the protection of CV spring-run Chinook salmon in Mill, Deer, Butte, and Big Chico creeks and the Yuba River have been added to the existing CDFG regulations. The current regulations, including those developed for Sacramento River winter-run Chinook salmon provide some level of protection for spring-run fish (CDFG 1998).

There is little information on steelhead harvest rates in California. Hallock *et al*. (1961) estimated that harvest rates for Sacramento River steelhead from the 1953-1954 through 1958-1959 seasons ranged from 25.1 percent to 45.6 percent assuming a 20 percent non-return rate of tags. The average annual harvest rate of adult steelhead above RBDD for the 3-year period from 1991-1992 through 1993-1994 was 16 percent (McEwan and Jackson 1996). Since 1998, all hatchery steelhead have been marked with an adipose fin clip allowing anglers to distinguish hatchery and wild steelhead. Current regulations restrict anglers from keeping unmarked steelhead in Central Valley streams. Overall, this regulation has greatly increased protection of naturally produced adult steelhead; however, the total number of CCV steelhead contacted might be a significant fraction of basin-wide escapement, and even low catch-and-release mortality may pose a problem for wild populations (Good *et al*. 2005).

Infectious disease is one of many factors that influence adult and juvenile salmonid survival. Salmonids are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment (NMFS 1996a, 1996b, 1998). Specific diseases such as bacterial kidney disease, *Ceratomyxosis shasta* (C-shasta), columnaris, furunculosis, infectious hematopoietic necrosis, redmouth and black spot disease, whirling disease, and erythrocytic inclusion body syndrome are known, among others, to affect steelhead and Chinook salmon (NMFS 1996a, 1996b, 1998). Very little current or historical information exists to quantify changes in infection levels and mortality rates attributable to these diseases; however, studies have shown that wild fish tend to be less susceptible to pathogens than are hatchery-reared fish. Nevertheless, wild salmonids may contract diseases that are spread through the water column (*i.e.*, waterborne pathogens) as well as through interbreeding with infected hatchery fish. The stress of being released into the wild from a controlled hatchery environment frequently causes latent infections to convert into a more pathological state, and increases the potential of transmission from hatchery reared fish to wild stocks within the same waters.

Accelerated predation also may be a factor in the decline of listed salmonids. Human-induced habitat changes such as alteration of natural flow regimes and installation of bank revetment and structures such as dams, bridges, water diversions, piers, and wharves often provide conditions that both disorient juvenile fish and attract predators (Stevens 1961; Decato 1978; Vogel *et al*. 1988; Garcia 1989). On the mainstem Sacramento River, high rates of predation are known to occur at the RBDD, Anderson-Cottonwood Irrigation District's (ACID) diversion dam, GCID's diversion facility, areas where rock revetment has replaced natural river bank vegetation, and at South Delta water diversion structures (*e.g*., Clifton Court Forebay; CDFG 1998). In passing the dam, juveniles are subject to conditions which greatly disorient them, making them highly susceptible to predation by fish or birds. Sacramento pikeminnow (*Ptychocheilus grandis*) and striped bass (*Morone saxatilis*) congregate below the dam and prey on juvenile salmon in the tail waters. The Sacramento pikeminnow is a species native to the Sacramento River basin and has co-evolved with the anadromous salmonids in this system. However, rearing conditions in the Sacramento River today (e.g. warm water, low-irregular flow, standing water, and water diversions) compared to its natural state and function decades ago in the pre-dam era, are more conducive to warm water species such as Sacramento pikeminnow and striped bass than to native salmonids.

For listed salmonids , the construction of high dams for hydropower, flood control, and water supply resulted in the loss of vast amounts of upstream habitat (*i.e*., approximately 80 percent, or a minimum linear estimate of over 1,000 stream miles), and often resulted in precipitous declines in affected populations. For example, the completion of Friant Dam in 1947 has been linked with the extirpation of spring-run Chinook salmon in the San Joaquin River upstream of the Merced River within just a few years. The reduced populations that remain below Central Valley dams are forced to spawn in lower elevation tailwater habitats of the mainstem rivers and tributaries that were previously not used for this purpose. This habitat is entirely dependent on managing reservoir releases to maintain cool water temperatures suitable for spawning, and/or rearing. This requirement has been difficult to achieve in all water year types and for all life stages of affected species. CCV steelhead, in particular, seem to require the qualities of small tributary habitat similar to what they historically used for spawning; habitat that is largely unavailable to them under the current water management scenario. All salmonid species considered in this consultation have been adversely affected by the production of hatchery fish associated with the mitigation for the habitat lost to dam construction (e.g., from genetic impacts, increased competition, exposure to novel diseases, etc.).

Long-term climate change is an additional consideration regarding the viability of the CV spring-run Chinook salmon ESU and specific populations in the long-term. Global and localized climate changes, such as El Nino ocean conditions and prolonged drought conditions, may play an important role in the suitability of spring-run Chinook salmon habitat and, hence, viability. The CV spring-run Chinook salmon ESU is highly vulnerable to drought conditions (NMFS 2009). An alarming prediction is that Sierra snow packs are expected to decrease with global warming and that the majority of runoff in California will be from rainfall in the winter rather than from melting snow pack in the mountains (CDWR 2006). This will alter river runoff patterns and transform the tributaries that feed the Central Valley from a spring/summer snowmelt dominated system to a winter rain dominated system. It can be hypothesized that

summer temperatures and flow levels will become unsuitable for salmonid survival. The cold snowmelt that furnishes the late spring and early summer runoff will be replaced by warmer precipitation runoff. This should truncate the period of time that suitable cold-water conditions exist below existing reservoirs and dams due to the warmer inflow temperatures to the reservoir from rain runoff. Without the necessary cold-water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures below reservoirs, such as Shasta Lake and Lake Oroville, potentially could rise above thermal tolerances for juvenile and adult salmonids (*i.e.* Central Valley steelhead) that must hold below the dam over the summer and fall periods. Increased winter precipitation, decreased snow pack, and permafrost degradation could affect the flow and temperature of rivers and streams, with negative impacts on fish populations and the habitat that supports them.

IV. ENVIRONMENTAL BASELINE

The environmental baseline "includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process" (50 CFR §402.02).

A. Status of the Species and Critical Habitat within the Action Area

1. Status of the Species within the Action Area

The action area is located near the city of Fresno, California on the upper reach of the San Joaquin River. It is located approximately 20 miles downstream from Friant Dam. Currently status-species fish have not been viewed as having access to this section of the San Joaquin due to the Hills-Ferry Barrier located at the confluence of the San Joaquin and Merced rivers and previously dry and barren conditions for the most part prior to 2009. It is thought though, that during high flows and other times of the year when the barrier is removed the CCV steelhead would have had access to the action area. CV spring-run Chinook salmon, as requisite with the SJRRP, is set to be in this portion of the river before December 31, 2012. The action area is also expected to provide spawning and rearing habitat for juveniles of these species.

Following is a status summary of these species and their habitat within the San Joaquin River and action area.

a. *CV spring-run Chinook Salmon*

The action area currently contains no known CV spring-run Chinook salmon. CV spring-run Chinook salmon are anticipated to be released below Friant Dam, no later than December 31, 2012, according to the NRDC, *et al*., v. Kirk Rodgers, *et al*. 2006 settlement which was the basis for the SJRRP.

Based on historical run-time observations of spring-run Chinook salmon in the San Joaquin River basin, adults are likely to be present in the action area during the upstream migration period between May and September, when they are migrating to upstream holding and spawning habitat. Spring-run Chinook salmon probably migrate downstream throughout the year, dispersing downstream as fry soon after emergence; early in their first summer as fingerlings; in the fall as flows increase; or after overwintering in freshwater as yearlings (Healey 1991).

b. *CCV steelhead*

Only historical information for the upper San Joaquin River exists regarding the abundance, location, and timing of steelhead spawning. However, in other drainage basins they are usually more widely distributed than Chinook salmon, and likely spawned and reared in tributaries above Friant Dam (Yoshiyama *et al*. 1996, Voight and Gale 1998, as cited in McEwan 2001). It is very likely that management of the mainstem San Joaquin River flows that is designed to restore Chinook salmon populations will provide adequate flows to support the upstream and downstream migration of steelhead, and may improve mainstem rearing habitat for steelhead as well. While migrating CCV steelhead may occur within the action area during the rainy season, adult presence is unlikely during the summer months. Rearing and migrating juveniles are likely to be present in the action area year around.

2. Status of Critical Habitat within the Action Area

The action area (*i.e*., upper San Joaquin River) has the potential to provide spawning and rearing habitat for CCV spring-run Chinook salmon and CCV steelhead with the implementation of the SJRRP. The action area is currently not designated critical habitat for CCV spring-run Chinook salmon or CCV steelhead. Habitat requirements for CV spring-run Chinook salmon and CCV steelhead within the action include adequate substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions.

B. Factors Affecting the Species in the Action Area

Interim flow water releases began from Friant Dam into the San Joaquin River on October 1, 2009. Flows from Friant have been continuous since then, but have fluctuated in terms of velocity in preparation for the reintroduction of CV spring-run Chinook salmon as mandated by the SJRRP. It is anticipated that the magnitude and duration of peak flows in the San Joaquin River during the winter and spring will be reduced by water impoundment upstream behind Friant Dam. Instream flows during the summer and early fall months will fluctuate due to deliveries of municipal and agricultural water supplies. Overall, water management reduces natural variability by creating more uniform flows year-round.

High summer water temperatures can create a thermal barrier to the migration of adult and juvenile salmonids (Kjelson *et al.* 1982; Rich 1997). Although cooler water is anticipated in the direct action area due to the proximity to Friant Dam, ambient air temperature in the summer months can be extreme causing fluctuations in the watershed. Water diversions, for agricultural

and municipal purposes are found throughout the San Joaquin River and entrain and kill juvenile and salmon and steelhead during emigration periods during fall, winter, and spring months.

Little is known about other factors, such as the quantity of macro invertebrates in the action area or appropriate rearing substrate, due to this portion of the river being mostly void of water for nearly 50 years.

C. Likelihood of Species Persistence in the Action Area

With the implementation of the SJRRP, the likelihood of CCV steelhead and CV spring-run Chinook salmon in the action area are very promising. Historically this area proved more than suitable for these species, and it is expectant that as the SJRRP continues its work and monitoring in the area that the species will begin to show increases in their populations again.

V. EFFECTS OF THE ACTION

Pursuant to Section 7(a)(2) of the ESA (16 U.S.C. §1536), Federal agencies are directed to ensure that their activities are not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. This biological opinion assesses the effects of the California High Speed Train: Merced to Fresno section on CV spring-run Chinook salmon and CCV steelhead. The proposed HST project is likely to adversely affect listed species through vibration from pile driving of the permanent piles for the new high speed train bridge and temporary sheet piles for the coffer dam and false work if needed. In the *Description of the Proposed Action* section of this Opinion, NMFS provided an overview of the action. In the *Status of the Species* and *Environmental Baseline* sections of this biological and conference opinion, NMFS provided an overview of the threatened and endangered species and critical habitat that are likely to be adversely affected by the activity under consultation.

Regulations that implement section 7(b)(2) of the ESA require NMFS to evaluate the direct and indirect effects of Federal actions and actions that are interrelated with or interdependent to the Federal action to determine if it would be reasonable to expect them to appreciably reduce listed species' likelihood of both surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (16 U.S.C. §1536; 50 CFR 402.02).

A. Approach to the Assessment

NMFS generally approaches “jeopardy” analyses in a series of steps. First, NMFS evaluates the available evidence to identify direct and indirect physical, chemical, and biotic effects of the proposed actions (these effects include direct impacts to a species habitat; modifications to something in the species’ environment - such as reducing a species’ prey base, enhancing populations of predators, altering its spawning substrate, altering its ambient temperature regimes; or adding something novel to a species’ environment - such as introducing exotic competitors or disruptive noises). Once NMFS has identified the effects of the action, the available evidence is evaluated to identify a species’ likelihood and extent of exposure to any adverse effects caused by the action (*i.e.* the extent of spatial and temporal overlap between the

species and the effects of the action). Once NMFS has identified the level of exposure that a species will have to the effects of the action, the available evidence is evaluated to identify the species' probable response, including physical and behavioral reactions, to these effects. These responses then will be assessed to determine if they can reasonably be expected to reduce a species' reproduction, numbers, or distribution (for example, by changing birth, death, immigration, or emigration rates; increasing the age at which individuals reach sexual maturity; decreasing the age at which individuals stop reproducing; among others). The available evidence is then used to determine if these reductions, if there are any, could reasonably be expected to appreciably reduce a species' likelihood of surviving and recovering in the wild.

1. Information Available for the Assessment

To conduct the assessment, NMFS examined an extensive amount of evidence from a variety of sources. Detailed background information on the status of these species and critical habitat has been published in a number of documents including peer reviewed scientific journals, primary reference materials, governmental and non-governmental reports, previous biological opinions, documents evaluating the effects of underwater noise from pile driving, the biological assessment for this project, and project meeting notes. Additional information investigating the effects of the project's actions on the listed species in question, their anticipated response to these actions, and the environmental consequences of the actions as a whole was obtained from the aforementioned resources. For information that has been taken directly from published, citable documents, those citations have been referenced in the text and listed at the end of this document.

2. Assumptions Underlying This Assessment

In the absence of definitive data or conclusive evidence, NMFS must make a logical series of assumptions to overcome the limits of the available information. These assumptions will be made using sound, scientific reasoning that can be logically derived from the available information. The progression of the reasoning will be stated for each assumption, and supporting evidence cited.

The potential adverse effects to listed species resulting from the proposed construction of the HST and the implementation of the mitigation features are primarily associated with elevated underwater sound pressure levels generated during pile driving. However, other potential impacts to listed salmonids include turbidity resulting from ground disturbance for areas associated with bridge construction and mitigation.

The information used in this assessment includes the Status of the Species and Environmental Baseline sections of this biological opinion, studies and accounts of the impacts of construction and pile driving activities on anadromous fish.

B. Assessment

The proposed HST project includes actions that may adversely affect several life stages of listed fish species. Adverse effects to these species and their habitat may result from changes in water quality from construction activities, loss of riparian vegetation from construction activities, and physical injury and harassment of juveniles and adults from exposure to elevated levels of underwater sound produced during pile driving. The project includes integrated design features to avoid and minimize many of these potential impacts.

As described in the environmental baseline, adult CCV steelhead enter freshwater to spawn between August to January with a peak migration period of September-October (Moyle 2002). The steelhead migration period overlaps the pile driving in-water work window (June 15-October 15. CV spring-run Chinook salmon historically entered the San Joaquin River from May through September and spawn in the autumn. Spring-run Chinook salmon probably migrate downstream throughout the year, dispersing downstream as fry soon after emergence; early in their first summer as fingerlings; in the fall as flows increase; or after overwintering in freshwater as yearlings (Healey 1991).

1. Pile Driving and Bridge Construction

The installation of steel piles with a vibratory hammer in the San Joaquin River is expected to result in adverse effects to exposed fish due to possibly high levels of underwater sound that will be produced. Adverse effects can range from physical injury to the exposed fish, sometimes resulting in death, to lesser impacts, such as behavioral modifications or increased susceptibility to predation, which do not necessarily result in death or long term adverse impacts by themselves. The degree to which an individual fish exposed to underwater sound will respond (from a startle response to immediate mortality) is dependent on a number of variables such as the species of fish, size of the fish, presence of a swimbladder, sound pressure intensity and frequency, shape of the sound wave (rise time), depth of the water around the pile and the bottom substrate composition and texture. Swimbladders, which are inflated with gas, can expand rapidly as the pressure waves pass through the fish and can press against, and strain, adjacent organs, such as the liver and kidney (Keevin and Hempen 1997). In addition, this pneumatic compression causes demonstrable injury, in the form of ruptured capillaries, internal bleeding, and maceration of highly vascular organs (Caltrans 2002). Hastings and Popper (2005) also noted that sound waves can cause different types of tissues to vibrate at different frequencies, and that this differential vibration can cause tearing of mesenteries and other sensitive connective tissues. Exposure to high noise levels can also lead to injury through “rectified diffusion,” the formation and growth of bubbles in tissues. These bubbles can cause inflammation, cellular damage, and blockage or rupture of capillaries, arteries, and veins (Crum and Mao 1996; Stroetz *et al.* 2001; Vlahakis and Hubmayr 2000). Death from barotrauma and rectified diffusion injuries can be instantaneous, or delayed for minutes, hours or even days after exposure.

NMFS is uses a single strike peak sound pressure level (SPL) of 206 dB and an accumulated sound exposure level (SEL) of 187 dB to correlate underwater sound with potential injury to fish. These are the thresholds that indicate the onset of physical injury. The SPL is an expression of the sound pressure using the decibel scale and the standard reference pressures of micro-Pascal

(1 μPa) for water and biological tissues. SEL is the exposure of fish to a total amount of energy (*i.e.*, dose) that can be used to determine a physical injury response. In other words, it is the time-integrated, sound-pressure-squared level. Because sound is a form of energy, the damage potential of a given sound environment will depend not only on its level, but also its duration. The root-mean-square (RMS) is 150 dB for a behavioral response in a fish. The level is determined by analyzing the waveform and computing the square root of the average of the squared pressures over the time period that comprises that portion of the waveform containing 90% of the sound (pressure squared) energy (Hastings and Popper 2005). This calculated RMS SPL is described as "RMS (impulse)" and is used to report an overall average SPL for a single pile driving pulse (Hastings and Popper 2005). Because all SEL measurements are normalized to a one second time interval, it may be used to compare the energy content of different exposures to sound. SEL is calculated by summing the cumulative pressure squared (p2) over time and is often used as an indication of the energy dose. The following table summarizes the criteria for injury to fish from underwater sound generated 10 meters (source level) from the pile driving (Table 4).

Table 4. Summary of interim criteria for injury to fish assuming a distance of 10 meters (source level from the driven pile).

Interim Criteria for Injury	Interim Criteria in Decibels (dB)	Fish Response
Peak	206 dB	physical injury
Cumulative SEL	187 dB (for fish 2 grams or larger); 183 dB (for fish less than 2 grams)	physical injury
Root Mean Square (RMS)	150 dB	behavioral response

The proposed project includes installation of up to 2 CIDH piles near the low flow channel of the San Joaquin River and possibly temporary pipe piles to hold temporary work trestles if need be. To reduce the likelihood of exposure to underwater noise levels, trestle and temporary bent pile installation will not begin until June 15, while installation of the CIDH piles are limited from July 15 through October 1. A coffer dam will be used for the near-water piles. This cofferdam will reduce the potential for higher sound, by allowing work to be done on more solid substrate, allowing for less vibration and impact than would have occurred in a more liquid substrate. This timing window allows in-water work to occur when the numbers of listed fish in the action area are at their lowest, and the life stages of listed fish are less vulnerable (*i.e.* larger and able to avoid the action area) to the potential effects.

The noise assessment prepared by the FRA/HSRA in the BA, breaks down the impacts from driving the permanent and temporary impacts. Peak sound levels would not exceed the interim

criteria of 206 dB, and the accumulated SEL criteria of 187 dB for adults and 183dB for juveniles would not be exceeded to all extent feasible. Pile driving will be conducted only during daylight hours and initially will be used at low energy levels and reduced impact frequency. Applied energy and frequency will be gradually increased until necessary full force and frequency are achieved. If temporary support structures are needed it is only expected to take 3-4 days to install. A conservative estimate for total bridge completion is two NMFS authorized work windows for near water work. The activities related to pile driving are temporary and will only last a short time during the duration of the in-water work activities. Sublethal and/or subinjurious effects to juvenile CV spring-run Chinook salmon and CCV steelhead, including altered behavior, auditory masking, and temporary hearing threshold shifts can affect vulnerability to predation, foraging success, and other factors that influence survival and fitness. Because daily pile driving activities will be separated by overnight rest periods when migration can precede uninhibited, upstream migration of listed fish are not expected to be significantly delayed. More extreme effects, including injury and mortality of migrating adults, could potentially occur during limited unattenuated pile driving. These effects will be limited to isolated, individual events at the beginning of project and the actual potential for listed fish to be exposed to an accumulated 187 dB SEL is relatively low due to the project location and the time period when construction will occur. The expected populations of CV spring-run Chinook salmon and CCV steelhead in the San Joaquin River represent a small number of the entire population in the Central Valley, and the action is expected to have little impact upon the entire ESU and DPS. There is potential for adult CV spring-run Chinook salmon and CCV steelhead to be adversely effected from pile driving activities, however, it is expected to be relatively low due to their larger bodies. In addition, pile driving activities would only occur in the daytime which will avoid crepuscular and nocturnal periods when salmonid migration is more common. Furthermore, use of a vibratory hammer instead of an impact hammer should lessen potential impacts even further.

2. Water Quality

NMFS anticipates that some local increases in turbidity will result as a consequence of these actions. The increases in local turbidity levels are associated with the re-suspension of bottom sediments during the piling installation phase of the construction process. The proposed in-water construction activities are not expected to lead to significant impacts to water quality in the action area. There are expected to be minor, short term increases in turbidity and sedimentation in localized areas due to the driving and removal of temporary piles. The expected increases in turbidity and suspended sediment may disrupt feeding and migratory behavior of listed fish over a small area for a short period of time. The turbidity associated with installation and removal of piles could result in localized displacement and likely behavioral modifications to individual salmonids if they do not readily move away from the areas directly affected by the project.

These temporary behavioral changes are not expected to result in injury or death of listed salmonids. NMFS does not anticipate that turbidity levels associated with the pile driving will increase to deleterious levels. Furthermore, turbidity conditions are expected to return to ambient levels within a couple of days to hours of the termination of pile driving actions.

Unanticipated spills into the San Joaquin River, such as toxic substances used at construction sites (gasoline and lubricants) can lead to adverse effects and mortality in juvenile and adult salmonids. If these toxins seep into the water, these substances can kill aquatic organisms through exposure to lethal concentrations or exposure to non-lethal levels that cause physiological stress and increased susceptibility to other sources of mortality. However, NMFS expects that the FRA and HSRA will adhere to the standard BMP's and SWPPP during construction activities to minimize or prevent these kinds of effects on listed salmonids. Therefore, NMFS does not expect the HST project will result in water contamination that will injure or kill listed anadromous fish.

3. Operations Phase

The HST is a passenger train and will not carry cargo composed of hazardous material. The train would be powered by an electrical current and thus would not emit fuels (i.e. oil, gasoline, etc.). There is not literature suggesting a negative effect to anadromous fish due to overhead power lines. In the unlikely event of a derailment, there would not be a risk to the environment from hazardous chemicals or materials. There is a potential for pollution from maintenance equipment or vehicles utilized along the HST primary right-of-way to leak and be redirected due to storm water runoff. The run-off however, would be directed as sheet flow into the adjacent drainage system or directed through swales to infiltration basins. The basins are designed as a water quality control measure. No runoff from the Merced to Fresno section would be discharged directly to any surface water bodies. Runoff from bridges, overpasses, underpasses, and aerial structures would be collected and discharged to infiltration basins or adjacent drainage systems. These potential effects are indirect, but have the possibility to occur for the duration the HST is operable.

VI. 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 ESA.

The HST Merced to Fresno section will construct a new bridge just east of the existing UPRR and SR99 bridge. Land surrounding the HST proposed project has two distinct settings. The first setting is where the new bridge will be located, which is within the confines of the San Joaquin River flood channel. Within the channel is open space designated as part of the Department of Fish and Games and San Joaquin Parkway and River Trust Camp Pashayne ecological reserve. The second environmental setting is outside of the river channel and consists of agricultural fields to the north and the city of Fresno to the south.

Federal actions that may affect the action area include the SJRRP, which is scheduled to have CV spring-run Chinook salmon below Friant Dam by December 31, 2012. Monitoring of this program is supposed to continue extensively through 2025 and then be reevaluated at this time.

There are no specific plans for further development within the action area of the proposed project at this time. Therefore, further cumulative effects beyond those described above are not expected.

VII. INTEGRATION AND SYNTHESIS

This section integrates and adds the current conditions described in the status of the species and the environmental baseline for the action area with the effects of the proposed action and the cumulative effects of future actions. The purpose of this synthesis is to review the effects of the action in addition to the environmental baseline to understand how the action will affect the likelihood of the species' continued survival.

A. Summary of Status of the Species and Environmental Baseline

1. CV spring-run Chinook salmon

Historically, the majority of spring-run in the Central Valley were produced in the Southern Sierra Nevada Diversity Group, which contains the San Joaquin River and its tributaries. All spring-run populations in this diversity group have been extirpated (Lindley *et al.* 2007). Lindley *et al.* (2007) determined that perhaps 15 of the 19 historical populations of spring-run are extinct, with their entire historical spawning habitats behind various impassable dams. Those authors only considered Butte, Deer, and Mill creeks as watersheds with persistent populations of Chinook salmon known as spring-run, although they recognized that phenotypic Chinook salmon persist within the FRH population spawning in the Feather River below Oroville Dam and in the Yuba River below Englebright Dam. All of those population fall within the Northern Sierra Nevada diversity group. Butte and Deer creek spring-run populations are at low risk of extinction, and the Mill Creek population is at either a moderate or low risk (Lindley *et al.* 2007). Viable CV spring-run Chinook salmon populations occur in only one of four diversity groups that historically contained them, and therefore fail the representation and redundancy rule for ESU viability (Lindley *et al*. 2007). Because the CV spring-run Chinook salmon ESU is spatially confined to relatively few remaining streams, continues to display broad fluctuations in abundance, and a large proportion of the population (*i.e.,* in Butte Creek) faces the risk of high mortality rates, the ESU remains at a moderate to high risk of extinction.

Past and present impacts within the Sacramento River basin have caused significant loss of habitat. Populations have declined drastically over the last century, and some subpopulations have been extirpated. The construction of dams has limited access to a large and significant portion of historical spawning and rearing. Dam operations have changed downstream flow patterns, effecting stream dynamics (*i.e.* geomorphology, habitat configuration, etc.), and affected available habitat through changes in water temperature characteristics, limiting gravel recruitment to available spawning reaches and limiting the introduction of LWM which contributes to habitat diversity.

Despite the currently non-existent genetic status of the San Joaquin River population, and the substantial reduction in habitat availability and suitability since the construction of Friant Dam,

the value of the upper San Joaquin River basin as prime spawning and habitat areas, its projected location as the southern-most extant population of spring-run Chinook salmon, and its suitability for such make it an important node of habitat for the survival and recovery of the species.

2. CCV steelhead

CCV steelhead historically were well-distributed throughout the Sacramento and San Joaquin Rivers (Busby *et al.* 1996) and were found from the upper Sacramento and Pit River systems (now inaccessible due to Shasta and Keswick Dams) south to the Kings and possibly the Kern river systems, and in both east- and west-side Sacramento River tributaries (Yoshiyama *et al.* 1996). Lindley *et al*. (2006) estimated that historically there were at least 81 independent CCV steelhead populations distributed primarily throughout the eastern tributaries of the Sacramento and San Joaquin rivers. This distribution has been greatly affected by dams (McEwan and Jackson 1996). Presently, impassable dams block access to 80 percent of historically available habitat, and block access to all historical spawning habitat for about 38 percent of historical populations (Lindley *et al*. 2006).

Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries, including Antelope, Deer, and Mill creeks and the Yuba River. Populations may exist in Big Chico and Butte creeks and a few wild steelhead are produced in the American and Feather rivers (McEwan and Jackson 1996). Snorkel surveys done in 1999 to 2002 indicate that steelhead are present in Clear Creek (Newton 2002). Because of the large resident *O. mykiss* population in Clear Creek, steelhead spawner abundance has not been estimated.

Spatial structure for steelhead is fragmented and reduced by elimination or significant reduction of the major core populations (*i.e.* Sacramento River, Feather River and American River) that provided a source for the numerous smaller tributary and intermittent stream populations like Dry Creek, Auburn Ravine, Yuba River, Deer Creek, Mill Creek, and Antelope Creek. Tributary populations can likely never achieve the size and variability of the core populations in the long-term, generally due to the size and available resources of the tributaries.

Lindley *et al*. (2007) indicated that prior population census estimates completed in the 1990s found the CCV steelhead spawning population above RBDD had a fairly strong negative population growth rate and small population size. Good *et al.* (2005) indicated the decline was continuing as evidenced by new information (Chipps Island trawl data). CCV steelhead populations generally show a continuing decline, an overall low abundance, and fluctuating return rates. The future of CCV steelhead is uncertain due to limited data concerning their status. However, Lindley *et al.* (2007) concluded that there is sufficient evidence to suggest that the DPS is at moderate to high risk of extinction.

Despite the substantial reduction in habitat availability and suitability since the construction of Friant Dam, the value of the upper San Joaquin River with the implementation of the SJRRP is expected to create greater spawning and rearing habitat making it an important node of habitat for the survival and recovery of the species.

B. Summary of the Effects of the Proposed Action on Listed Species Likelihood of Survival and Recovery

Under the proposed HST project, adverse impacts to listed species stemming from increased sedimentation, use of a cofferdam, and acoustic impacts from pile driving are expected to occur. Even though these impacts may cause physiological stress to the extent that the normal behavior patterns (e.g., feeding, sheltering and migration) of affected individuals may be disrupted, due to the timing of pile driving activities, the overall changes in turbidity and suspended sediment associated with this project are not expected to adversely affect listed species. These impacts are primarily low-level, short-term alteration of habitat conditions. Potential impacts are expected to be minimized by meeting California Central Valley Regional Water Quality Control Board (CVRWQCB) water quality objectives, implementing BMPs for erosion control, implementing the fish rescue plan inside the cofferdam, staging equipment outside of the riparian corridor, limiting the amount of riparian vegetation removal, and restoring disturbed riparian habitat values at the project site. It is also unlikely during this period of pile driving activities that adults of either species aforementioned will be present.

Pile driving activities are scheduled to occur June 15-October 1. Elevated levels of underwater sound around the pile driving activities may cause temporary behavioral changes, loss or reduction of hearing in affected fish, and/or mortality to listed fish. These impacts will be substantially minimized by the pile driving work window restriction and by using an attenuation casing for vibratory hammer-driven temporary piles 24-inches or greater in diameter during the period of June 15-July 14. Loss of short-term hearing sensitivities in juvenile fish will expose them to higher risks of predation. Fish with impacted hearing capacities will have a lower ability to detect predators and may be unable to maintain position in the water column (inner ear equilibrium factors). NMFS believes that this limited exposure to underwater sound levels that would cause behavioral effects, injury, and/or mortality is unlikely to significantly affect growth or survival of exposed adult and juvenile salmonids. Construction lapses, including daily breaks and nighttime non-working periods, as well as long periods when no pile driving is scheduled to occur, will allow fish to migrate through the action area and minimize the extent of impacts to survival and recovery of salmonid populations. In addition, a low proportion of the population of fish in the San Joaquin River will be exposed to the pile driving activities.

1. <u>CV spring-run Chinook salmon</u>

The new HST bridge over the San Joaquin River will be a permanent structure. However, this will not impede listed anadromous fish, such as spring-run Chinook salmon rearing and migration. The construction of the new HST bridge is temporary and the pile driving effects on fish will only last as long as the duration of two summer seasons. In addition, piles will be placed outside the wetted river channel. Therefore, adverse effects to spring-run Chinook salmon are expected to occur only during the seasonal in-water work window. These adverse effects will not appreciably reduce the likelihood of survival and recovery of the CV spring-run Chinook salmon. Injury to Chinook salmon will be at a peak single strike peak sound pressure level (SPL) of 206 dB, 10 meters from the pile driving, between June 15 and October 1. Mortality is expected if sound levels reach above cumulative SEL 187 dB during June 15 to October 1. However, fish presence in the action area is expected to be low. It is expected that

the effects of the proposed project, when considered in the context of the current baseline and likely future cumulative effects, would not appreciably reduce the likelihood of survival and recovery of the CV spring-run Chinook salmon ESU throughout its range.

2. CCV steelhead

NMFS anticipates that the proposed project will result in the exposure of a small number of adult and juvenile CCV steelhead to increased levels of turbidity and suspended sediment, as well as noise from pile driving activities. The exposure to noise in particular is expected to adversely affect a small number of individuals. During June 15 to October 1, noise from pile driving may delay or impede fish migration causing increased energy expenditure by affected individuals, but as single strike sound pressure levels are not expected to exceed 206 dB and SEL of 187 dB, no direct mortality of juvenile or adult fish is expected at 10 meters from the piles.

The elevated stress levels may degrade the fish's health and the reproductive potential of adults, and increase the potential of juveniles to be preyed upon by striped bass or other large predators due to impaired behavioral and physiological responses. Individuals that appear different in their behavior attract predators, and thus experience higher mortality due to predator attacks. Even so, given the low level of exposure expected to result from adherence to the limited seasonal and diurnal in-water work windows, the limited adverse response expected from the few individuals of the San Joaquin River population that are exposed to these adverse effects, and the relatively small contribution to juvenile production that the upper San Joaquin River provides to the overall population numbers for the CCV steelhead DPS, it is expected that the effects of the proposed project, when considered in the context of the current baseline and likely future cumulative effects, would not appreciably reduce the likelihood of survival and recovery of the CCV steelhead DPS throughout its range.

C. Summary of Effects of the Proposed Action on Critical Habitat

The location of the action area is not currently considered critical habitat.

VIII. CONCLUSION

After reviewing the best scientific and commercial data available, including the environmental baseline, the effects of the proposed project, and the cumulative effects, it is NMFS biological opinion that the HST Merced to Fresno is not likely to jeopardize the continued existence of threatened CV spring-run Chinook salmon or threatened CCV steelhead.

IX. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS as an act which kills or injures

fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose of the agency action is not considered to be prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be undertaken by the FRA and HSRA, as appropriate, for the exemption in section 7(o)(2) to apply. The FRA and the HSRA has a continuing duty to regulate the activity covered by this incidental take statement. If the FRA and the HSRA (1) fail to assume and implement the terms and conditions or (2) fail to require any contractors to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to any contract, permit or grant documents, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the HSRA must report the progress of the action and its impact on the species to NMFS as specified in the incidental take statement [50 CFR §402.14(i)(3)].

A. Amount or Extent of Take

NMFS anticipates incidental take of CV spring-run Chinook salmon and CCV steelhead from impacts directly related to pile driving and cofferdam activities and impairment of essential behavior patterns as a result of these activities. The incidental take is expected to be in the form of harm, harassment, or mortality of CV spring-run Chinook salmon and CCV steelhead, resulting from the installation and removal of temporary and permanent piles, the installation of a cofferdam and the dewatering associated with it, as well as periodic maintenance checks on the piers in the form of dive/snorkel surveys. Incidental take is expected to occur for two in-water work window seasons, from June 15 through October 15 (over the course of two years), when individuals of CV spring-run Chinook salmon and CCV steelhead could potentially be in the action area. Take is expected to be limited to migrating adults, and migrating, rearing and smolting juveniles.

NMFS cannot, using the best available information, quantify the anticipated incidental take of individual CV spring-run Chinook salmon and CCV steelhead because of the variability and uncertainty associated with the population size of each species, annual variations in the timing of migration, and uncertainties regarding individual habitat use of the project area. In lieu of such quantification, NMFS has identified ecological surrogates containing parameters that define the acceptable take level.

<u>Ecological Surrogates</u>

1. The number of salmonids that may be incidentally taken during activities is expected to be small. NMFS will use the area of sound pressure wave impacts extending into the water column from each pile, and the time period for pile driving as a surrogate for number of fish. The analysis of the effects of the

proposed project anticipates that the construction of the false work would require driving 35 steel, 2 foot diameter piles over roughly 7 to 10 days (approximately 30 minutes driving time per pile using a vibratory hammer, with 5 piles driven during an 8 hour work day), and the installation of the new bridge's permanent structure will require placing 2 CIDH piles over a period of 15 days, adding up to a total of between 22 and 25 days of pile driving over a period of 4 months (June 15 through October 15). If the FRA/HSRA monitoring indicates that sound pressure levels greater than 206 dB peak, or 187 dB SEL, extend beyond these periods the amount of incidental take may be exceeded.

2. Take in the form of mortality of stranded juvenile CCV steelhead and CV spring-run Chinook salmon during the dewatering activities from June 15 to October 15. Take will be a small percentage of the relocated (salvaged) CCV steelhead and CV spring-run Chinook salmon juveniles. There is potential for listed juvenile fish to be directly killed or injured as a result of the fish salvage. A low mortality rate (expected to be less than 10 percent if consistent with the results of fish handling in similar fish salvage efforts) is expected from capturing and handling. Fish that are captured and released may temporarily become startled or stressed. Fish salvage operations should minimize the number of juveniles lost, but it is anticipated that some mortality may occur.

3. The analysis of the effects of the proposed project anticipates that the turbidity levels produced by installation/removal of piles will not exceed those permitted under the project SWPPP and that if turbidity levels approach or exceed the acceptable criteria established by the Regional Water Quality Control Board (CRWQCB), construction activities will be halted until turbidity levels return to within acceptable levels.

If these ecological surrogates are not met and maintained, the proposed project will be considered to have exceeded anticipated take levels, thus requiring FRA/HSRA to coordinate with NMFS within 24 hours on ways to reduce the amount of take down to anticipated levels. Anticipated incidental take will be exceeded if the criteria described above are not met, the Project is not implemented as described in the Biological Assessment (BA) prepared for this project, all conservation measures are not implemented as described in the BA (including successful completion of monitoring and reporting criteria), or the project is not implemented in compliance with the terms and conditions of this incidental take statement. If take is exceeded formal consultation must be reinitiated (50 C.F.R. § 402.16(a)).

B. Effect of Take

NMFS has determined that the level of take resulting from the construction of the proposed project is not likely to jeopardize the continued existence of CV spring-run Chinook salmon or CV steelhead.

C. Reasonable and Prudent Measures

NMFS has determined that the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize the incidental take of listed anadromous fish.

1. Measures shall be taken to minimize the amount and duration of pile driving and its potential impacts on listed salmonids, and to monitor the range and magnitude of compression shock waves generated by pile driving operations.

2. Measures shall be taken to maintain, monitor, and adaptively manage all conservation measures throughout the life of the project to ensure their effectiveness.

D. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the FRA and HSRA must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary:

1. Measures shall be taken to minimize the amount and duration of pile driving and its potential impacts on listed salmonids, and to monitor the range and magnitude of compression shock waves generated by pile driving operations.

   - The FRA and HSRA shall monitor underwater sound during all vibratory hammer pile driving activities on land or in water. If underwater sound produced on a single day exceeds the maximum allowable level of single strike 206 dB peak at 10 meters from the pile being installed or SEL 187 dB, then NMFS must be contacted within 24 hours.

   - Pile driving shall occur only during daylight hours from one hour after sunrise to one hour before sunset. This is to ensure that pile driving does not occur at dawn or dusk, during peak salmonid migration and feeding times.

2. Measures shall be taken to minimize the amount of "take" during cofferdam instillation and dewatering activities.

   - NMFS anticipates incidental take of juvenile CV spring-run Chinook salmon and CCV steelhead from impacts directly related to dewatering activities. The incidental take is expected to be in the form of harm or mortality of juvenile CV spring-run Chinook salmon and CCV steelhead resulting from seining and electrofishing. Take is expected to be limited to migrating, rearing and smolting juveniles. Take in the form of mortality of stranded juvenile CV steelhead and CV spring-run Chinook salmon during the dewatering activities from June 15 to October 15 shall be less

than 10 percent of the relocated (salvaged) CV steelhead and CV spring-run Chinook salmon juveniles. Fish salvage operations should minimize the number of juveniles lost.

- A report shall be submitted to NMFS within 30 days of relocation activities indicating the number of listed species that were loss due to mortality and injury and the number of listed species that were relocated without harm. This report should be sent to:

Central Valley Office
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento CA 95814
FAX: (916) 930-3629
Phone: (916) 930-3600

3. Measures shall be taken to maintain, monitor, and adaptively manage all conservation measures throughout the life of the project to ensure their effectiveness.

- The FRA or HSRA on behalf of the FRA shall purchase riparian credits at a NMFS approved anadromous fish conservation bank at a 3:1 ratio for the aerial extent of riparian habitat affected by the action.

- The FRA or HSRA on behalf of the FRA shall monitor and maintain all onsite riparian plantings within the action area for three years, and provide irrigation, fertilization, and replacement plantings as necessary to insure full and rapid recovery of disturbed riparian habitat features beneficial to anadromous fish.

- If a listed species is observed injured or killed by project activities, FRA and/or HSRA shall contact Sierra Franks at NMFS within 48 hours at 916-930-3720 or 650 Capitol Mall, Suite 5-100, Sacramento, CA 95814. Notification shall include species identification, the number of fish, and a description of the action that resulted in take. If possible, dead individuals shall be collected, placed in an airtight bag, and refrigerated with the aforementioned information until further direction is received from NMFS.

- Annual updates and reports required by these terms and conditions shall be submitted by December 31 of each year during the construction period to:

Central Valley Office
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento CA 95814
FAX: (916) 930-3629
Phone: (916) 930-3600

XI. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

1. The FRA and HSRA should advise their contractor to follow these water quality measures during construction of the proposed project.

- The contractor will implement all applicable Best Management Practices (BMPs) to avoid sedimentation, spills, etc.

- The contractor will be required to prepare a Storm Water Pollution Prevention Plan (SWPPP).

- During construction, all equipment refueling and maintenance shall occur more than 200 feet from the main channel, except for the pile driver(s) or other stationary equipment. Any spill within the floodplain and active channel of the San Joaquin River shall be reported to NMFS, CDFG and any other appropriate resource agencies within 48 hours.

- The contractor shall have an absorbent boom available within 250 feet of the live channel during all in or near channel work to be readily prepared for quick containment of any unanticipated spills within or adjacent to the San Joaquin River.

- All measures from the 1602 Streambed Alteration Agreement, 404 and 401 water quality certifications/permits will be adhered to.

2. Any riparian vegetation removal within 250 feet of the San Joaquin River, that cannot be restored onsite, must be mitigated offsite at a ratio of 3:1.

3. The FRA and HSRA should support and promote aquatic and riparian habitat restoration within the San Joaquin River Basin, and implement practices that avoid or minimize negative impacts to salmon and steelhead on all of their project sites.

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

XII. REINITIATION NOTICE

This concludes formal consultation on the High Speed Train, Merced to Fresno section. 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 retained (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 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, formal consultation shall be reinitiated immediately.

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Enclosure 2

Magnuson-Stevens Fishery Conservation and Management Act

ESSENTIAL FISH HABITAT CONSERVATION RECOMMENDATIONS

I. IDENTIFICATION OF ESSENTIAL FISH HABITAT

The Magnuson-Stevens Fishery Conservation and Management Act (MSA), as amended (U.S.C. 180 *et seq*.), requires that Essential Fish Habitat (EFH) be identified and described in Federal fishery management plans (FMPs). Federal action agencies must consult with NOAA's National Marine Fisheries Service (NMFS) on any activity which they fund, permit, or carry out that may adversely affect EFH. NMFS is required to provide EFH conservation and enhancement recommendations to the Federal action agencies.

EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purposes of interpreting the definition of EFH, "water" includes aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and a healthy ecosystem; and, "spawning, breeding, feeding, or growth to maturity" covers all habitat types used by a species throughout its life cycle. The proposed project site is within the region identified as EFH for Pacific salmon in Amendment 14 of the Pacific Salmon FMP.

An adverse effect is defined as any impact which reduces the quality and/or quantity of essential fish habitat. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality and/or quantity of (EFH). Adverse effects to EFH may result from actions occurring within EFH or outside of EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions. (50 CFR 600.810)

The Pacific Fishery Management Council (PFMC) has identified and described EFH, Adverse Impacts and Recommended Conservation Measures for salmon in Amendment 14 to the Pacific Coast Salmon FMP (PFMC 1999). Freshwater EFH for Pacific salmon in the California Central Valley includes waters currently or historically accessible to salmon within the Central Valley ecosystem as described in Myers *et al.* (1998), and includes the San Joaquin-Lower Chowchilla hydraulic unit (18040001). Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*), and Central Valley fall-/late fall-run Chinook salmon (*O. tshawytscha*) are species under the Salmon Plan that occur in the San Joaquin-Lower Chowchilla hydrologic unit.

Historical factors limiting salmon populations in the San Joaquin-Lower Chowchilla hydraulic unit include primarily the building of Friant Dam. Once Friant became completely operational the decision was made not to release any water for fish and wildlife purposes. Though approximately 52,000 acre feet were released for downstream riparian users the flow ceased after Gravelly Ford. This decision effectively dewatered some 62 miles of channel downstream of this point (Raines 1992). Despite the efforts by state and federal agency personnel to get salmon past the dry reaches, the lower beds were unreachable to the spawning salmon. The runs continued to return and die in the river until 1949. After that the San Joaquin Chinook was extirpated in its southernmost range. (sierrafoothill.org 2006)

In September 2006 an 18-year lawsuit to provide sufficient fish habitat in the San Joaquin River below Friant Dam near Fresno, California, by the U.S. Departments of the Interior and Commerce, the Natural Resources Defense Council (NRDC), and the Friant Water Users Authority (FWUA) reached a Settlement. The Settlement received Federal court approval in October 2006. (restoresjr.net 2011) In October 2009 flows were released from Friant, and have continued to do so continually since. By December 31, 2012, in accordance with the settlement CV spring-run Chinook salmon are to be reintroduced to this section of the San Joaquin River.

A. Life History and Habitat Requirements

1. Pacific Salmon

General life history information for Central Valley Chinook salmon is summarized below. Further detailed information on Chinook salmon Evolutionarily Significant Units (ESUs) are available in the NMFS status review of Chinook salmon from Washington, Idaho, Oregon, and California (Myers *et al.* 1998), and the NMFS proposed rule for listing several ESUs of Chinook salmon (63 FR 11482).

Adult Central Valley fall-run Chinook salmon enter the Sacramento and San Joaquin Rivers from July through December and spawn from October through December while adult Central Valley late fall-run Chinook salmon enter the Sacramento and San Joaquin Rivers from October to April and spawn from January to April (U.S. Fish and Wildlife Service [FWS] 1998). Chinook salmon spawning generally occurs in clean loose gravel in swift, relatively shallow riffles or along the edges of fast runs (NMFS 1997).

Egg incubation occurs from October through March (Reynolds *et al.* 1993). Shortly after emergence from their gravel nests, most fry disperse downstream towards the Delta and into the San Francisco Bay and its estuarine waters (Kjelson *et al.* 1982). The remaining fry hide in the gravel or station in calm, shallow waters with bank cover such as tree roots, logs, and submerged or overhead vegetation. These juveniles feed and grow from January through mid-May, and emigrate to the Delta and estuary from mid-March through mid-June (Lister and Genoe 1970). As they grow, the juveniles associate with coarser substrates along the stream margin or farther from shore (Healey 1991). Along the emigration route, submerged and overhead cover in the form of rocks, aquatic and riparian vegetation, logs, and undercut banks provide habitat for food organisms, shade, and protect juveniles and smolts from predation. These smolts generally spend a very short time in the Delta and estuary before entry into the ocean.

II. PROPOSED ACTION

The proposed action is described in section II (Description of the Proposed Action) of the preceding biological and conference opinion for threatened California Central Valley steelhead (*Oncorhynchus mykiss*), and Central Valley spring-run Chinook salmon (*O. tshawytscha*) (Enclosure 1).

III. EFFECTS OF THE PROJECT ACTION

The effects of the proposed action on salmonid habitat (*i.e.*, for spring and fall/late fall-run Chinook salmon) are described at length in section V (Effects of the Action) of the preceding biological opinion, and generally are expected to apply to Pacific salmon EFH.

Effects to EFH stemming from construction activities that may contribute sediment and increase turbidity will be avoided or minimized by meeting Regional Water Quality Board objectives, implementing applicable BMPs, staging equipment outside of the riparian corridor, limiting the amount of riparian vegetation removal, and replacing lost riparian vegetation at the project site.

EFH will be adversely affected by the disturbance of up to 0.05 acres of riparian vegetation as a result of construction activities as well as the occupation of the riverbed and water column by temporary work trestles and the columns of the new bridge's substructure. The majority of these impacts are expected to be temporary, as all disturbed areas outside the actual footprint of the new bridge would be restored to preconstruction conditions and any areas of disturbed vegetation would be replanted with native riparian vegetation. Additionally, implementation of the proposed project would result in a permanent net increase of riverine habitat since this project would result in no piers being located within the wetted channel.

IV. CONCLUSION

Based on the best available information, and upon review of the effects of the proposed HST Merced to Fresno section, NMFS believes that the construction and operation of the project features may adversely affect EFH for Pacific salmon protected under MSA. However, the proposed action includes adequate measures (described in the preceding biological opinion and the EFH conservation recommendations below) to avoid, minimize, or otherwise offset the adverse effects to EFH.

V. EFH CONSERVATION RECOMMENDATIONS

As the habitat requirements of Central Valley fall-run Chinook salmon within the action area are similar to those of the federally listed species addressed in the attached biological opinion, NMFS recommends that the FRA or HSRA on behalf of the FRA purchase riparian credits at a NMFS approved anadromous fish conservation bank at a 3:1 ratio for the aerial extent of riparian habitat affected by the action and the FRA or HSRA on behalf of the FRA shall monitor and maintain all onsite riparian plantings within the action area for three years, and provide irrigation, fertilization, and replacement plantings as necessary to insure full and rapid recovery of disturbed riparian habitat features beneficial to anadromous

Those terms and conditions which require the submittal of reports and status updates can be disregarded for the purposes of this EFH consultation as there is no need to duplicate those submittals.

VI. STATUTORY REQUIREMENTS

Section 305 (b) 4(B) of the MSA requires that the Federal lead agency provide NMFS with a detailed written response within 30 days, and 10 days in advance of any action, to the EFH conservation recommendations, including a description of measures adopted by the lead agency for avoiding, minimizing, or mitigating the impact of the project on EFH (50 CFR §600.920[j]). In the case of a response that is inconsistent with our recommendations, the lead agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreement with NMFS over the anticipated effects of the proposed action and the measures needed to avoid, minimize, or mitigate such effects.

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