Enclosure 1

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
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BIOLOGICAL OPINION

Agency: U.S. Fish and Wildlife Service

Activity: Fish Passage Improvement at Diversion

Consultation Conducted By: West Coast Region, National Marine Fisheries Service

File Number: 151422WCR2014SA00136

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I. BACKGROUND AND CONSULTATION HISTORY

Through a grant from the Anadromous Fish Restoration Program (AFRP), part of the Central Valley Improvement Act (CVPIA: Title 34 of Public Law 102-575, Section 3406(b)(1)), the U.S. Fish and Wildlife Service (USFWS) is funding the South Fork Cottonwood Creek Hammer Diversion Fish Passage Improvement Project (Fish Passage Project). Also included in this consultation, the California Department of Fish and Wildlife (CDFW) will be removing the existing dam through a separate agreement with USFWS.

Hammer Technical Team meetings were held during 2013, with participation from NOAA's National Marine Fisheries Service (NMFS) biologist and engineer, USFWS, and CDFW. On March 6, 2014, NMFS received request for formal consultation on the proposed Fish Passage Project. The USFWS has determined that the proposed Fish Passage Project may affect, and is likely to adversely affect the federally listed as threatened California Central Valley (CV) steelhead distinct population segment (DPS), but is not likely to adversely affect the federally listed as threatened CV spring-run Chinook salmon Evolutionarily Significant Unit (ESU). Therefore, NMFS will not be including description of the status of the species, or discussion of effects of the proposed action on CV spring-run Chinook salmon in this Biological Opinion.

USFWS has been designated as the lead action agency for this project by the U.S. Army Corps of Engineers (Corps). The Corps will be issuing USFWS a permit for this project (SPK-2014-00062). This biological opinion will therefore satisfy the requirements for the Corps to consult with NMFS under section 7 of the ESA of 1973, as amended (16 U.S.C 1531 et seq.) for this project.

II. DESCRIPTION OF THE PROPOSED ACTION

A. Project Description

The proposed Fish Passage Project is located on private property, approximately 35 miles west of the city of Red Bluff, in Tehama County, California. The proposed Fish Passage Project will improve fish passage for anadromous fish in the South Fork of Cottonwood Creek, approximately 35 river miles upstream of the confluence with Cottonwood Creek. The removal of the Hammer Diversion Dam will provide access for fish to the upper five river miles of historic spawning and rearing habitat above the existing dam.

The design features that may impact listed California CV steelhead include:

(1) Demolition of existing dam – Dam removal will occur using explosives, specifically a binary explosive (two-part) called Helix. A series of holes will be drilled into the dam and existing fish ladder steps with air powered drills. These holes will be deck-loaded with one third-pound sticks of Helix which will have detonating cord attached to the stick and to one of three detonating cord trunk lines. Each trunk line will be initiated with a time delay cap. A Nonel shock tube will be used with a starter to initiate the shots from a safe location by a licensed blaster. The drilling will take approximately two days. The loading, blasting and cleanup will take one additional day on the following day. Due to the extremely remote location of the dam (no vehicle access), concrete rubble will be broken into small pieces by the blast and left in place, after exposed metal has been removed. The dam concrete is composed of cement that was imported to the site and aggregate materials that were harvested from the project site. Equipment and materials for the demolition will be mobilized to the project site using a helicopter. The explosives will be manually mobilized to the site. A generator/compressor will be used to power the drills;

(2) Construction of an intake and pump facility (meeting NMFS/CDFW criteria) - The new pump station will be located at the current point of diversion, which is about 100 feet upstream of the dam. The primary reason for maintaining the diversion in its current location is to limit the total dynamic head to approximately eight feet and reduce the required pump size. A disadvantage to maintaining the diversion in the current location is that the pump and screen will need to be removed at the end of the diversion season and re-installed the following spring, and access to the site is difficult.

Under existing conditions, approximately three cubic feet per second (cfs) is continually diverted through an unscreened headgate structure located upstream of the dam. In the interest of accomplishing the project goals the landowner has decided that a minimum of 30 gallons per minute (0.07 cfs) would meet his irrigation and fire suppression needs. Flows would be used to irrigate vegetation downslope from his diversion ditch, an orchard, and a garden. Flows for fire suppression are conveyed to a pond near the residence where they are temporarily stored or pumped to the new storage system.

The proposed pump facility will divert a maximum of approximately 40 gallons per minute (gpm) during daylight hours. Average pump rates will likely range from approximately 25 to 40 gpm during peak daylight hours. The pump is powered directly from the PV array and operates

only during daylight hours. A pre-fabricated Pump-Rite screen designed to meet NMFS passive screen criteria at 130 gpm flow is proposed as the solar pump intake. The NMFS Fish Passage Design Criteria (NMFS 2001) states the passive screen approach velocity should be 0.2 feet per second (fps) or less. The CDFW criterion states the maximum approach velocity should be 1/4 of active screen approach velocity (0.4 fps) or 0.1 fps. Therefore, a screen rated to meet NMFS criteria at 80 gpm was selected. The M-L130 model meets these criteria. The screen will be placed on angle support such that the minimum clearance of 2.5 inches from streambed is met. The screen will be removed at the end of diversion season for storage. The selected Pump-Rite screen model is extremely lightweight and the landowner sees no problem with seasonal installation.

The pump station includes a Dankoff Solar SunCentric Model 7446 pump placed on a pedestal. A two-inch suction hose will extend from the screen to the pump. A one-inch discharge line will extend from the pump outlet to the existing intake structure located at the tunnel entrance. The pump will be powered by two PV modules, which will be mounted on supports above the 100-year water level or above an elevation of 1,505.0 feet. The location of bedrock below the surface sediments at the diversion site and the elevation of the water surface at low flows following dam removal are not known. However, the screen location can be adjusted easily in the future to changes in streambed after dam removal;

(3) Plant riparian vegetation - Suitable riparian vegetation will be planted on new bars that are formed downstream of the dam from the transport of coarse sediment stored behind the dam, and along the new low-water line upstream of the dam. The planting will be deferred to the year after the dam removal in order to allow fall and winter floods to move coarse sediment and form the new planting surfaces; and

(4) Conduct post-project monitoring - will be conducted by the USFWS. Pebble counts and cross-section and longitudinal profile surveys will be conducted upstream and downstream of the current diversion dam location, annually for three years following project implementation to monitor changes in channel form. The methods will follow those currently being used by Northwest Hydraulic Consultants (NHC) to document pre-project conditions.

Habitat monitoring will occur approximately the first and fifth year after project implementation to monitor fish habitat conditions. Additional monitoring may be conducted, based on winter flow patterns. The methods will follow those currently being used by USFWS to document pre-project conditions. In addition, a water temperature monitor will be installed to monitor the effects of the project on stream temperatures.

Riparian habitat upstream and downstream of the current diversion dam location will be monitored annually for three years to ensure that riparian species are establishing on new downstream bars and along the new low-water level upstream of the current diversion dam location.

B. Proposed Conservation and Avoidance Measures

(1) A riparian wetland planting plan will be prepared to replace impacted riparian wetlands by a measure of quantity and quality equal to or exceeding impacts of the project using appropriate native riparian trees and shrubs.

(2) Following the initial winter flows after dam removal, the area along the new low water line upstream of the former dam, and new point bars formed immediately downstream of the former dam will be revegetated in accordance with the riparian wetland planting plan.

(3) After ground-disturbing activities are complete, all disturbed areas (outside of the active stream channel and the ditch bottom) shall be seeded with native plant species and mulched.

(4) Ditch piping shall occur when the ditch is not flowing.

(5) Dam removal shall be conducted between June 15 and October 1 to minimize impacts to CV steelhead by working when water temperatures are warmer and CV steelhead are less likely to be present, and flows are at their lowest. Additionally, this time period avoids spawning and egg incubation.

(6) Time delays will be used for the blasting operations during dam demolition to minimize the level of ground vibration and reduce the risk of damage to the nearby tunnel.

(7) Measure SOIL / GEO-3 regarding the use of time delays for blasting operations will be fully implemented to minimize the level of blast-induced overpressure rises.

(8) Prior to dam removal, exclusionary fish netting shall be installed approximately 500 feet upstream and 500 feet downstream of the diversion structure. U.S. Fish and Wildlife Service, in coordination and consultation with NMFS and CDFW, will ensure that qualified fish biologists are onsite to implement fish relocation operations through the use of herding, seining and / or electrofishing, if necessary. Best professional determination will be used to decide which method(s) of collection and relocation is most appropriate. Biologists will first try to haze and herd fish out of the fish exclusion area. If fish biologists determine that the use of electrofishing is necessary for the efficient and successful removal of fish, the NMFS electrofishing guidelines (NMFS 2000) will be strictly followed. The fish relocation team will be comprised of fishery biologists with professional experience using seines and electrofishing equipment.

C. Description of Action Area

The Fish Passage Project action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. The project site is located approximately 35 miles west of Red Bluff, in Tehama County, along South Fork Cottonwood Creek, approximately 35 river miles upstream of the confluence with Cottonwood Creek. The area subject to the proposed Federal action encompasses the project boundary, with buffers to account for noise, turbidity and future adjustments to the stream channel following dam removal. The action area also includes two miles downstream of the diversion dam to

account for increased turbidity and sediment deposition following dam removal, and 0.15 miles upstream of the diversion dam to account for predicted adjustments to the stream channel in the years following dam removal.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

The following federally listed species DPS and designated critical habitat occur in the action area and may be affected by the proposed Fish Passage Project:

California CV steelhead DPS (referred to as CV steelhead throughout this biological opinion)
(*Oncorhynchus mykiss*) Originally listed as threatened on March 19, 1998 (63 FR 13347)
CV steelhead designated critical habitat
(September 2, 2005, 70 FR 52488)

A. Species and Critical Habitat Listing History

CV steelhead were originally listed as threatened on March 19, 1998, (63 FR 13347). Following a status review (Good *et al.* 2005) and after application of the agency's hatchery listing policy, NMFS reaffirmed its status as threatened and also listed the Feather River Hatchery and Coleman National Fish Hatchery stocks as part of the DPS in 2006 (71 FR 834). In June 2004, after a complete status review of 27 west coast salmonid evolutionarily significant units and DPSs, NMFS proposed that CV steelhead remain listed as threatened (69 FR 33102). On January 5, 2006, NMFS reaffirmed the threatened status of the CV steelhead and applied the DPS policy to the species because the resident and anadromous life forms of *O. mykiss* remain "markedly separated" as a consequence of physical, ecological and behavioral factors, and therefore warranted delineation as a separate DPS (71 FR 834). On August 15, 2011, NMFS completed another 5-year status review of CV steelhead and recommended that the CV steelhead DPS remain classified as a threatened species (NMFS 2011). Critical habitat was designated for CV steelhead on September 2, 2005 (70 FR 52488).

B. Critical Habitat

Critical habitat for CV steelhead includes stream reaches such as those of the Sacramento, Feather, and Yuba rivers (including tributaries of the Sacramento River), and Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries, and the waterways of the Delta (Fig. X). Currently the CV steelhead DPS and critical habitat extends up the San Joaquin River up to the confluence with the Merced River. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation (defined as the level at which water begins to leave the channel and move into the floodplain; it is reached at a discharge that generally has a recurrence interval of 1 to 2 years on the annual flood series) (Bain and Stevenson 1999; 70 FR 52488). Critical habitat for CV steelhead is defined as specific areas that contain the primary constituent elements (PCEs) and physical habitat elements essential to the

conservation of the species. Following are the inland habitat types used as PCEs for CV steelhead:

a. Freshwater Spawning Habitat

Freshwater spawning sites are those with water quantity and quality conditions and substrate supporting spawning, egg incubation, and larval development. Most of the available spawning habitat for steelhead in the Central Valley is located in areas directly downstream of dams due to inaccessibility to historical spawning areas upstream and the fact that dams are typically built at high gradient locations. These reaches are often impacted by the upstream impoundments, particularly over the summer months, when high temperatures can have adverse effects upon salmonids spawning and rearing below the dams. Even in degraded reaches, spawning habitat has a high conservation value as its function directly affects the spawning success and reproductive potential of listed salmonids.

b. Freshwater Rearing Habitat

Freshwater rearing sites are those with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and survival; water quality and forage supporting juvenile development; and natural cover such as shade, submerged and overhanging large woody material (LWM), log jams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks. Both spawning areas and migratory corridors comprise rearing habitat for juveniles, which feed and grow before and during their outmigration. Non-natal, intermittent tributaries also may be used for juvenile rearing. Rearing habitat condition is strongly affected by habitat complexity, food supply, and the presence of predators of juvenile salmonids. Some complex, productive habitats with floodplains remain in the system (*e.g.*, the lower Cosumnes River, Sacramento River reaches with setback levees [*i.e.*, primarily located upstream of the City of Colusa]) and flood bypasses (*i.e.*, Yolo and Sutter bypasses). However, the channelized, leveed, and riprapped river reaches and sloughs that are common in the Sacramento-San Joaquin system typically have low habitat complexity, low abundance of food organisms, and offer little protection from either fish or avian predators. Freshwater rearing habitat also has a high conservation value even if the current conditions are significantly degraded from their natural state. Juvenile life stages of salmonids are dependent on the function of this habitat for successful survival and recruitment.

c. Freshwater Migration Corridors

Ideal freshwater migration corridors are free of migratory obstructions, with water quantity and quality conditions that enhance migratory movements. They contain natural cover such as riparian canopy structure, submerged and overhanging large woody objects, aquatic vegetation, large rocks, and boulders, side channels, and undercut banks which augment juvenile and adult mobility, survival, and food supply. Migratory corridors are downstream of the spawning areas and include the lower mainstems of the Sacramento and San Joaquin rivers and the Delta. These corridors allow the upstream and downstream passage of adults, and the emigration of smolts. Migratory habitat condition is strongly affected by the presence of barriers, which can include

dams (*i.e.*, hydropower, flood control, and irrigation flashboard dams), unscreened or poorly screened diversions, degraded water quality, or behavioral impediments to migration. For successful survival and recruitment of salmonids, freshwater migration corridors must function sufficiently to provide adequate passage. For this reason, freshwater migration corridors are considered to have a high conservation value even if the migration corridors are significantly degraded compared to their natural state.

d. Estuarine Areas

Estuarine areas free of migratory obstructions with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and salt water are included as a PCE. Natural cover such as submerged and overhanging LWM, aquatic vegetation, and side channels, are suitable for juvenile and adult foraging. Estuarine areas are considered to have a high conservation value as they provide factors which function to provide predator avoidance and as a transitional zone to the ocean environment.

C. Life History

1. California Central Valley Steelhead

Egg to Parr Stages

The length of time it takes for eggs to hatch depends mostly on water temperature. Steelhead eggs hatch in three to four weeks at 10°C (50°F) to 15°C (59°F) (Moyle 2002). 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 1986). 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 in the course of a few days, and start to feed actively, often in schools (Barnhart 1986; NMFS 1996).

The newly emerged juveniles move to shallow, protected areas associated within the stream margin (McEwan and Jackson 1996). As steelhead parr increase in size and their swimming abilities improve, they increasingly exhibit a preference for higher velocity and deeper mid-channel areas (Hartman 1965; Everest and Chapman 1972; Fontaine 1988).

Productive juvenile rearing habitat is characterized by complexity, primarily in the form of cover, which can be deep pools, woody debris, aquatic vegetation, or bolders. Cover is an important habitat component for juvenile steelhead both as velocity refugia and as a means of avoiding predation (Meehan and Bjornn 1991). Optimal water temperatures for growth range from 15°C (59°F) to 20°C (68°F) (McCullough *et al.* 2001, Spina 2006). Cherry *et al.* (1975) found preferred temperatures for rainbow trout ranged from 11°C (51.8°F) to 21°C (69.8°F) depending on acclimation temperatures (cited in Myrick and Cech 2001).

Smolt Migration

Juvenile steelhead will often migrate downstream as parr in the summer or fall of their first year of life, but this is not a true smolt migration (Loch *et al.* 1988). Smolt migrations occur in the late winter through spring, when juveniles have undergone a physiological transformation to survive in the ocean, and become slender in shape, bright silvery in coloration, with no visible parr marks. Emigrating steelhead smolts use the lower reaches of the Sacramento River and the Delta primarily as a migration corridor to the ocean. There is little evidence that they rear in the Delta or on floodplains, though there are few behavioral studies of this life-stage in the California Central Valley.

Ocean Behavior

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 1986). It is possible that California steelhead may not migrate to the Gulf of Alaska region of the north Pacific as commonly as more northern populations such as those inWashington and British Colombia. (Burgner 1993) reported that no coded-wire tagged steelhead from California hatcheries were recovered from the open ocean surveys or fisheries that were sampled for steelhead between 1980 and 1988. Only a small number of disk-tagged fish from California were captured. This behavior might explain the small average size of CV steelhead relative to populations in the Pacific Northwest, as food abundance in the nearshore coastal zone may not be as high as in the Gulf of Alaska.

(Pearcy 1990) found that the diets of juvenile steelhead caught in coastal waters of Oregon and Washington were highly diverse and included many species of insects, copepods, andamphipods, but by biomass the dominant prey items were small fishes (including rockfish and greenling) and euphausids . There are no commercial fisheries for steelhead in California, Oregon, or Washington, with the exception of some tribal fisheries in Washington waters.

Spawning

CV steelhead generally enter freshwater from August to November (with a peak in September – Hallock (1961), and spawn from December to April, with a peak in January through March, in rivers and streams where cold, well oxygenated water is available (Table 1; Williams 2006; Hallock *et al.* 1961; McEwan and Jackson 1996). The timing of upstream migration is correlated with high flow events, such as freshets, and the associated change in water temperatures (Workman *et al.* 2002). Adults typically spend a few months in freshwater before spawning (Williams 2006), but very little is known about where they hold between entering freshwater and spawning in rivers and streams. The threshold of a 56°F maximum water temperature that is commonly used for Chinook salmon is often extended to steelhead, but temperatures for spawning steelhead are not usually a concern as this activity occurs in the late fall and winter months when water temperatures are low. Female steelhead construct redds in suitable gravel and cobble substrate, primarily in pool tailouts and heads of riffles.

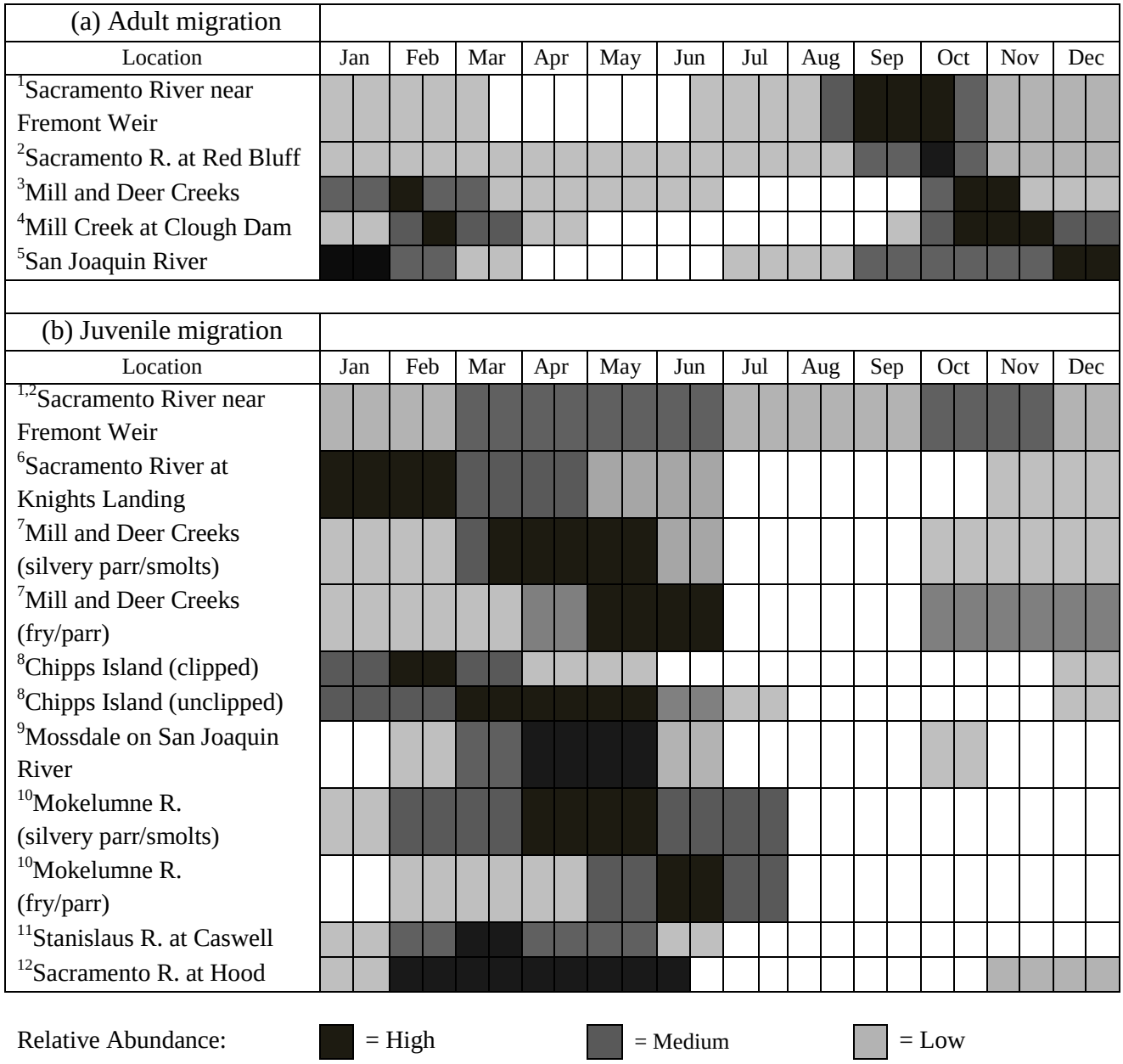
Few direct counts of fecundity are available for CV steelhead populations, but since the number of eggs laid per female is highly correlated with adult size, adult size can be used to estimate fecundity with reasonable precision. Adult steelhead size depends on the duration of and growth rate during their ocean residency (Meehan and Bjornn 1991). CV steelhead generally return to freshwater after one or two years at sea (Hallock *et al.* 1961), and adults typically range in size from two to twelve pounds (Reynolds *et al.* 1993). Steelhead about 55 cm (FL) long may have fewer than 2,000 eggs, whereas steelhead 85 cm (FL) long can have 5,000 to 10,000 eggs, depending on the stock (Meehan and Bjornn 1991). The average for CNFH since 1999 is about 3,900 eggs per female (USFWS 2011).

Unlike Pacific salmon, steelhead are iteroparous, meaning they are capable of spawning multiple times before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; and repeat spawners tend to be biased towards 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 were relatively numerous (17.2 percent) in Waddell Creek. Null *et al.* (2013) found between 36 percent and 48 percent of kelts released from CNFH in 2005 and 2006 survived to spawn the following spring, which is in sharp contrast to what Hallock (1989) reported for CNFH in the 1971 season, where only 1.1 percent of adults were fish that had been tagged the previous year. Most populations have never been studied to determine the percentage of repeat spawners. Hatchery steelhead are typically less likely than wild fish to survive to spawn a second time (Leider *et al.* 1986).

Kelts

Post-spawning steelhead (kelts) may migrate downstream to the ocean immediately after spawning, or they may spend several weeks holding in pools before outmigrating (Shapovalov and Taft 1954). Recent studies have shown that kelts may remain in freshwater for an entire year after spawning (Teo *et al.* 2011), but that most return to the ocean (Null *et al.* 2013).

Table 1. The temporal occurrence of (a) adult and (b) juvenile CV steelhead at locations in the Central Valley. Darker shades indicate months of greatest relative abundance.



Sources: [1](Hallock 1957); [2](McEwan 2001); [3](Harvey 1995); [4]CDFW unpublished data; [5]CDFG Steelhead Report Card Data 2007; [6]NMFS analysis of 1998-2011 CDFW data; [7](Johnson and Merrick 2012); [8]NMFS analysis of 1998-2011 USFWS data; [9]NMFS analysis of 2003-2011 USFWS data; [10]unpublished EBMUD RST data for 2008-2013; [11]Oakdale RST data (collected by Fishbio) summarized by John Hannon (Reclamation) ; [12](Schaffter 1980).

D. Factors Affecting Listed Species and Critical Habitat

California's robust agricultural economy and rapidly increasing urban growth place high demand for water in the Sacramento and San Joaquin river basins. The demand for water in the Central Valley has significantly altered the natural morphology and hydrology of the Sacramento and San Joaquin rivers and their major tributaries. Agricultural lands and urban areas have flourished on historic floodplains. An extensive flood management system of dams, levees, and bypass channels restricts the river's natural sinuosity, volume, and reduces the lag time of water flowing through the system. An impressive network of water delivery systems have transformed the Central Valley drainage system into a series of lined conveyance channels and reservoirs that are operated by several pumping facilities. Flood management and water delivery systems, in addition to agricultural, grazing, and urban land uses, are the main anthropogenic factors affecting watersheds in the action area.

A number of documents have addressed the history of human activities, present environmental conditions, and factors contributing to the decline of salmon and steelhead species in the Central Valley (*e.g*., Busby *et al.* 1996, Myers *et al.* 1998, Good *et al.* 2005, CALFED 2000). NMFS has also assessed the factors contributing to Chinook salmon and steelhead decline in supplemental documents (NMFS 1996, 1998) and Federal Register notices (*e.g*., June 16, 1993, 58 FR 33212; January 4, 1994, 59 FR 440; May 6, 1997, 62 FR 24588; August 18, 1997, 62 FR 43937; March 19, 1998, 63 FR 13347; May 5, 1999, 64 FR 24049; September 16, 1999, 64 FR 50394; February 16, 2000, 65 FR 7764). The foremost reason for the decline in these anadromous salmonid populations is the degradation and destruction of habitat (*e.g.*, substrate, water quality, water quantity, water temperature, water velocity, shelter, food, riparian vegetation, and migration conditions). Additional factors contributing to the decline of these populations include: over-utilization, disease or predation, the inadequacy of existing regulatory mechanisms, and other natural and manmade factors including global climate change. All of these factors have contributed to the ESA-listing of these fish and deterioration of their critical habitats. However, it is widely recognized in numerous species accounts in the peer-reviewed literature that the modification and curtailment of habitat and range have had the most substantial impacts on the abundance, distribution, population growth, and diversity of salmonid ESUs and DPSs. Although habitat and ecosystem restoration has contributed to recent improvements in habitat conditions throughout the ESUs/DPSs, global climate change remains a looming threat. The following general description of the factors affecting the viability of CV steelhead is based on a summarization of these documents.

1. Habitat Blockage

Lindley et al. (2006) estimated that 80 percent of historically available steelhead habitat, and 38 percent of spawning habitat has been lost to impassable dams. CV steelhead historically had at least 81 independent populations (Lindley *et al.* 2006). As a result of migration barriers, steelhead populations have been confined to lower elevation mainstems that historically were used only for migration. Population abundances have declined in these streams due to decreased quantity and quality of spawning and rearing habitat. Higher temperatures at these lower elevations during summer and fall are also a major stressor to adult and juvenile salmonids.

2. Water Development

The diversion and storage of natural flows by dams and diversion structures on Central Valley waterways have depleted stream flows and altered the natural cycles by which juvenile and adult salmonids base their migrations. As much as 60 percent of the natural historical inflow to Central Valley watersheds and the Delta have been diverted for human uses. Depleted flows have contributed to higher temperatures, lower dissolved oxygen (DO) levels, and decreased recruitment of gravel and LWM. More uniform flows year round have resulted in diminished natural channel formation, altered food web processes, and slower regeneration of riparian vegetation. These stable flow patterns have reduced bed load movement (Mount 1995, Ayers 2001), caused spawning gravels to become embedded, and decreased channel widths due to channel incision, all of which has decreased the available spawning and rearing habitat below dams. The storage of unimpeded runoff in these large reservoirs also has altered the normal hydrograph for the Sacramento and San Joaquin river watersheds. Rather than seeing peak flows in these river systems following winter rain events (Sacramento River) or spring snow melt (San Joaquin River), the current hydrology has truncated peaks with a prolonged period of elevated flows (compared to historical levels) continuing into the summer dry season.

Water withdrawals, for agricultural and municipal purposes have reduced river flows and increased temperatures during the critical summer months, and in some cases, have been of a sufficient magnitude to result in reverse flows in the lower San Joaquin River (Reynolds *et al*. 1993). Direct relationships exist between water temperature, water flow, and juvenile salmonid survival (Brandes and McLain 2001). Elevated water temperatures in the Sacramento River have limited the survival of young salmon in those waters. Juvenile fall-run Chinook salmon survival in the Sacramento River is also directly related with June streamflow and June and July Delta outflow (Dettman *et al*. 1987).

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 River, San Joaquin River, 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. 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). Most of the 370 water diversions operating in Suisun Marsh are unscreened (Herren and Kawasaki 2001).

Outmigrant juvenile salmonids in the Delta have been subjected to adverse environmental conditions created by water export operations at the CVP and SWP facilities. Specifically, juvenile salmonid survival has been reduced by the following: (1) water diversion from the mainstem Sacramento River into the Central Delta via the Delta Cross Channel (DCC); (2) upstream or reverse flows of water in the lower San Joaquin River and southern Delta waterways; (3) entrainment at the CVP and SWP export facilities and associated problems at Clifton Court Forebay; and (4) increased exposure to introduced, non-native predators such as striped bass (*Morone saxatilis*), largemouth bass (*Micropterus salmoides*), and sunfishes

(Centrarchidae). On June 4, 2009, NMFS issued a biological and conference opinion on the long-term operations of the CVP and SWP (NMFS 2009a). As a result of the jeopardy and adverse modification determinations, NMFS provided a reasonable and prudent alternative that reduces many of the adverse effects of the CVP and SWP resulting from the stressors described above.

3. Water Conveyance and Flood Control

The development of the water conveyance system in the Delta has resulted in the construction of more than 1,100 miles of channels and diversions to increase channel elevations and flow capacity of the channels (Mount 1995). Levee development in the Central Valley affects spawning habitat, freshwater rearing habitat, freshwater migration corridors, and estuarine habitat PCEs. As Mount (1995) indicates, there is an "underlying, fundamental conflict inherent in this channelization." Natural rivers strive to achieve dynamic equilibrium to handle a watersheds supply of discharge and sediment (Mount 1995). 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 erosive forces. The effects of channelization, and riprapping, 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 material. These changes generally reduce the range of habitat conditions 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).

Prior to the 1970s, there was so much woody material resulting from poor logging practices that many streams were completely clogged and were thought to have been total barriers to fish migration. As a result, in the 1960s and early 1970s it was common practice among fishery management agencies to remove woody material thought to be a barrier to fish migration (NMFS 1996b). However, it is now recognized that too much LWM was removed from the streams resulting in a loss of salmonid habitat and it is thought that the large scale removal of woody material prior to 1980 had major, long-term negative effects on rearing habitats for salmonids in northern California (NMFS 1996b). Areas that were subjected to this removal of LWM are still limited in the recovery of salmonid stocks; this limitation could be expected to persist for 50 to 100 years following removal of woody material.

Large quantities of downed trees are a functionally important component of many streams (NMFS 1996b). LWM influences stream morphology by affecting channel pattern, position, and geometry, as well as pool formation (Keller and Swanson 1979, Bilby 1984, Robison and Beschta 1990). Reduction of wood in the stream channel, either from past or present activities, generally reduces pool quantity and quality, alters stream shading which can affect water temperature regimes and nutrient input, and can eliminate critical stream habitat needed for both

vertebrate and invertebrate populations. Removal of vegetation also can destabilize marginally stable slopes by increasing the subsurface water load, lowering root strength, and altering water flow patterns in the slope.

In addition, the armoring and revetment of stream banks tends to narrow rivers, reducing the amount of habitat per unit channel length (Sweeney *et al*. 2004). As a result of river narrowing, benthic habitat decreases and the number of macroinvertebrates, such as stoneflies and mayflies, per unit channel length decreases affecting salmonid food supply.

4. Land Use Activities

Land use activities continue to have large impacts on salmonid habitat in the Central Valley watershed. Until about 150 years ago, the Sacramento River was bordered by up to 500,000 acres of riparian forest, with bands of vegetation extending outward for 4 or 5 miles (California Resources Agency 1989). Starting with the gold rush, these vast riparian forests were cleared for building materials, fuel, and to clear land for farms on the raised natural levee banks. The degradation and fragmentation of riparian habitat continued with extensive flood control and bank protection projects, together with the conversion of the fertile riparian lands to agriculture outside of the natural levee belt. By 1979, riparian habitat along the Sacramento River diminished to 11,000 to 12,000 acres, or about 2 percent of historic levels (McGill 1987). The clearing of the riparian forests removed a vital source of snags and driftwood in the Sacramento and San Joaquin River basins. This has reduced the volume of LWM input needed to form and maintain stream habitat that salmon depend on in their various life stages. In addition to this loss of LWM sources, removal of snags and obstructions from the active river channel for navigational safety has further reduced the presence of LWM in the Sacramento and San Joaquin rivers, as well as the Delta.

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 DO levels. Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning and egg and fry survival (Waters 1995).

Land use activities associated with road construction, urban development, logging, mining, agriculture, and recreation have significantly altered fish habitat quantity and quality through the alteration of stream bank and channel morphology; alteration of ambient water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWM; and removal of riparian vegetation, resulting in increased stream bank erosion (Meehan 1991). Urban stormwater and agricultural runoff may be contaminated with herbicides and pesticides, petroleum products, sediment, *etc*. Agricultural practices in the Central Valley have eliminated large trees and logs and other woody material that would otherwise be recruited into the stream channel (NMFS 1998).

Since the 1850s, wetlands reclamation for urban and agricultural development has caused the cumulative loss of 79 and 94 percent of the tidal marsh habitat in the Delta downstream and upstream of Chipps Island, respectively (Conomos *et al.* 1985, Nichols *et al.* 1986, Wright and Phillips 1988, Monroe *et al.* 1992, Goals Project 1999). Prior to 1850, approximately 1400 km^2 of freshwater marsh surrounded the confluence of the Sacramento and San Joaquin rivers, and another 800 km^2 of saltwater marsh fringed San Francisco Bay's margins. Of the original 2,200 km^2 of tidally influenced marsh, only about 125 km^2 of undiked marsh remains today. In Suisun Marsh, saltwater intrusion and land subsidence gradually has led to the decline of agricultural production. Presently, Suisun Marsh consists largely of tidal sloughs and managed wetlands for duck clubs, which first were established in the 1870s in western Suisun Marsh (Goals Project 1999). Even more extensive losses of wetland marshes occurred in the Sacramento and San Joaquin river basins. Little of the extensive tracts of wetland marshes that existed prior to 1850 along the valley's river systems and within the natural flood basins exist today. Most has been "reclaimed" for agricultural purposes, leaving only small remnant patches.

Dredging of river channels to enhance inland maritime trade and to provide raw material for levee construction has significantly and detrimentally altered the natural hydrology and function of the river systems in the Central Valley. Starting in the mid-1800s, the United States Army Corp of Engineers (Corps) and other private consortiums began straightening river channels and artificially deepening them to enhance shipping commerce. This has led to declines in the natural meandering of river channels and the formation of pool and riffle segments. The deepening of channels beyond their natural depth also has led to a significant alteration in the transport of bed load in the riverine system as well as the local flow velocity in the channel (Mount 1995). The Sacramento Flood Control Project at the turn of the nineteenth century ushered in the start of large scale Corps actions in the Delta and along the rivers of California for reclamation and flood control. The creation of levees and the deep shipping channels reduced the natural tendency of the San Joaquin and Sacramento rivers to create floodplains along their banks with seasonal inundations during the wet winter season and the spring snow melt periods. These annual inundations provided necessary habitat for rearing and foraging of juvenile native fish that evolved with this flooding process. The armored riprapped levee banks and active maintenance actions of Reclamation Districts precluded the establishment of ecologically important riparian vegetation, introduction of valuable LWM from these riparian corridors, and the productive intertidal mudflats characteristic of the undisturbed Delta habitat.

Urban storm water and agricultural runoff may be contaminated with pesticides, oil, grease, heavy metals, polycyclic aromatic hydrocarbons (PAHs), and other organics and nutrients (California Regional Water Quality Control Board-Central Valley Region [Regional Board] 1998) that can potentially destroy aquatic life necessary for salmonid survival (NMFS 1996a,b). Point source (PS) and non-point source (NPS) pollution occurs at almost every point that 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 are

exposed to increased water temperatures as a result of thermal inputs from municipal, industrial, and agricultural discharges.

Past mining activities routinely resulted in the removal of spawning gravels from streams, the straightening and channelization of the stream corridor from dredging activities, and the leaching of toxic effluents into streams from mining operations. Many of the effects of past mining operations continue to impact salmonid habitat today. Current mining practices include suction dredging (sand and gravel mining), placer mining, lode mining and gravel mining. Present day mining practices are typically less intrusive than historic operations (hydraulic mining); however, adverse impacts to salmonid habitat still occur as a result of present-day mining activities. Sand and gravel are used for a large variety of construction activities including base material and asphalt, road bedding, drain rock for leach fields, and aggregate mix for concrete to construct buildings and highways.

Most aggregate is derived principally from pits in active floodplains, pits in inactive river terrace deposits, or directly from the active channel. Other sources include hard rock quarries and mining from deposits within reservoirs. Extraction sites located along or in active floodplains present particular problems for anadromous salmonids. Physical alteration of the stream channel may result in the destruction of existing riparian vegetation and the reduction of available area for seedling establishment (Stillwater Sciences 2002). Loss of vegetation impacts riparian and aquatic habitat by causing a loss of the temperature moderating effects of shade and cover, and habitat diversity. Extensive degradation may induce a decline in the alluvial water table, as the banks are effectively drained to a lowered level, affecting riparian vegetation and water supply (NMFS 1996b). Altering the natural channel configuration will reduce salmonid habitat diversity by creating a wide, shallow channel lacking in the pools and cover necessary for all life stages of anadromous salmonids. In addition, waste products resulting from past and present mining activities, include cyanide (an agent used to extract gold from ore), copper, zinc, cadmium, mercury, asbestos, nickel, chromium, and lead.

Juvenile salmonids are exposed to increased water temperatures in the Delta during the late spring and summer due to the loss of riparian shading, and by thermal inputs from municipal, industrial, and agricultural discharges. Studies by California Department of Water Resources (DWR) on water quality in the Delta over the last 30 years show a steady decline in the food sources available for juvenile salmonids and sturgeon and an increase in the clarity of the water due to a reduction in phytoplankton and zooplankton. These conditions have contributed to increased mortality of juvenile Chinook salmon, steelhead, and sturgeon as they move through the Delta.

5. Water Quality

The water quality of the Delta has been negatively impacted over the last 150 years. Increased water temperatures, decreased dissolved oxygen (DO) levels, and increased turbidity and contaminant loads have degraded the quality of the aquatic habitat for the rearing and migration of salmonids. The Regional Board, in its 1998 Clean Water Act §303(d) list characterized the Delta as an impaired waterbody having elevated levels of chlorpyrifos, dichlorodiphenyltrichlor (*i.e.* DDT), diazinon, electrical conductivity, Group A pesticides (aldrin, dieldrin, chlordane,

endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexanes [including lindane], endosulfan and toxaphene), mercury, low DO, organic enrichment, and unknown toxicities (Regional Board 1998, 2001).

In general, water degradation or contamination can lead to either acute toxicity, resulting in death when concentrations are sufficiently elevated, or more typically, when concentrations are lower, to chronic or sublethal effects that reduce the physical health of the organism, and lessens its survival over an extended period of time. Mortality may become a secondary effect due to compromised physiology or behavioral changes that lessen the organism's ability to carry out its normal activities. For example, increased levels of heavy metals are detrimental to the health of an organism because they interfere with metabolic functions by inhibiting key enzyme activity in metabolic pathways, decrease neurological function, degrade cardiovascular output, and act as mutagens, teratogens or carcinogens in exposed organisms (Rand *et al*. 1995, Goyer 1996). For listed species, these effects may occur directly to the listed fish or to its prey base, which reduces the forage base available to the listed species.

In the aquatic environment, most anthropogenic chemicals and waste materials including toxic organic and inorganic chemicals eventually accumulate in sediment (Ingersoll 1995). Direct exposure to contaminated sediments may cause deleterious effects to listed salmonids or the threatened green sturgeon. This may occur if a fish swims through a plume of the resuspended 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 1994). However, the more likely route of exposure to salmonids or sturgeon is through the food chain, when the 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 and green sturgeon depends on their trophic level and the amount of contaminated forage base they consume. Response of salmonids and green sturgeon to contaminated sediments is similar to water borne exposures.

Low DO levels frequently are observed in the portion of the Stockton deep water ship channel (DWSC) extending from Channel Point, downstream to Turner and Columbia cuts. For example, over the 5-year period, starting in August 2000, a DO meter recorded channel DO levels at Rough and Ready Island (Dock 20 of the West Complex). Over the course of this time period, there have been 297 days in which violations of the 5 mg/L DO criteria for the protection of aquatic life in the San Joaquin River between Channel Point and Turner and Columbia cuts have occurred during the September through May migratory period for salmonids in the San Joaquin River. The data derived from the California Data Exchange Center files indicate that DO depressions occur during all migratory months, with significant events occurring from November through March when listed CV steelhead adults and smolts would be utilizing this portion of the San Joaquin River as a migratory corridor.

Potential factors that contribute to these DO depressions are reduced river flows through the ship channel, released ammonia from the City of Stockton Wastewater Treatment Plant, upstream

contributions of organic materials (*e.g.*, algal loads, nutrients, agricultural discharges) and the increased volume of the dredged ship channel. During the winter and early spring emigration period, increased ammonia concentrations in the discharges from the City of Stockton Waste Water Treatment Facility lowers the DO in the adjacent DWSC near the West Complex. In addition to the adverse effects of the lowered DO on salmonid physiology, ammonia is in itself toxic to salmonids at low concentrations. Likewise, adult fish migrating upstream will encounter lowered DO in the DWSC as they move upstream in the fall and early winter due to low flows and excessive algal and nutrient loads coming downstream from the upper San Joaquin River watershed. Levels of DO below 5 mg/L have been reported as delaying or blocking fall-run Chinook salmon in studies conducted by Hallock *et al.* (1970).

6. Hatchery Operations and Practices

Four hatcheries currently produce steelhead in the Central Valley. Releasing large numbers of hatchery fish can pose a threat to natural-origin steelhead stocks through genetic impacts, competition for food and other resources between hatchery and wild fish, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991). The genetic impacts of artificial propagation programs in the Central Valley primarily are caused by straying of hatchery fish and the subsequent interbreeding of hatchery fish with wild fish. In the Central Valley, practices such as transferring eggs between hatcheries and trucking smolts to distant sites for release contribute to elevated straying levels [Department of the Interior (DOI) 1999]. For example, the original source of steelhead broodstock at Nimbus Hatchery on the American River originally came from the Eel River basin and was not from the Central Valley. Thus, the progeny from that initial broodstock served as the basis for the hatchery steelhead reared and released from the Nimbus Fish Hatchery. One of the recommendations in the Joint Hatchery Review Report (NMFS and CDFG 2001) was to identify and designate new sources of steelhead brood stock to replace the current Eel River origin brood stock.

The management of hatcheries, such as Nimbus Hatchery, can directly impact steelhead populations by oversaturating the natural carrying capacity of the limited habitat available below dams. At Nimbus Hatchery, operating Folsom Dam to meet temperature requirements for returning hatchery fall-run Chinook salmon often limits the amount of water available for steelhead spawning and rearing the rest of the year within the American River downstream of Nimbus Dam.

The increase in Central Valley hatchery production has reversed the composition of the steelhead population, from 88 percent naturally-produced fish in the 1950s (McEwan 2001) to an estimated 23 percent to 37 percent naturally-produced fish by 2000 (Nobriga and Cadrett 2003), and less than 10 percent currently. The increase in hatchery steelhead production proportionate to the wild population has reduced the viability of the wild steelhead populations, increased the use of out-of-basin stocks for hatchery production, and increased straying (NMFS and CDFG 2001). Thus, the ability of natural populations to successfully reproduce and continue their genetic integrity likely has been diminished.

The relatively low number of spawners needed to sustain a hatchery population can result in high harvest-to-escapements ratios in waters where fishing regulations are set according to hatchery population. This can lead to over-exploitation and reduction in the size of wild populations existing in the same system as hatchery populations due to incidental bycatch (McEwan 2001).

Hatcheries also can have some positive effects on salmonid populations. Artificial propagation has been shown to be effective in bolstering the numbers of naturally spawning fish in the short term under specific scenarios. Artificial propagation programs can also aid in conserving genetic resources and guarding against catastrophic loss of naturally spawned populations at critically low abundance levels. However, relative abundance is only one component of a viable salmonid population.

7. Over Utilization

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 natural-origin 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 CV 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).

8. Disease and Predation

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, C*eratomyxosis 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 CV steelhead. 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 salmonids and attract predators (Stevens 1961, Decato 1978, Vogel *et al.* 1988, Garcia 1989).

On the mainstem Sacramento River, high rates of predation have been known to occur at the RBDD, Anderson-Cottonwood Irrigation District's (ACID) diversion dam, Glenn-Colusa Irrigation District'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 a 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 congregate downstream of 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. Tucker *et al.* (1998) reported that predation during the summer months by Sacramento pikeminnow on juvenile salmonids increased to 66 percent of the total weight of stomach contents in the predatory pikeminnow. Striped bass showed a strong preference for juvenile salmonids as prey during this study. This research also indicated that the percent frequency of occurrence for juvenile salmonids nearly equaled other fish species in the stomach contents of the predatory fish.

Predation on juvenile salmonids has increased as a result of water development activities which have created ideal habitats for predators and non-native invasive species (NIS). Turbulent conditions near dam bypasses, turbine outfalls, water conveyances, and spillways disorient juvenile salmonid migrants and increase their predator avoidance response time, thus improving predator success. Increased exposure to predators has also resulted from reduced water flow through reservoirs; a condition which has increased juvenile travel time. Other locations in the Central Valley where predation is of concern include flood bypasses, post-release sites for salmonids salvaged at the CVP and SWP Fish Facilities, and the Suisun Marsh Salinity Control Gates (SMSCG). Predation on salmon by striped bass and Sacramento pikeminnow at salvage release sites in the Delta and lower Sacramento River has been documented (Orsi 1967, Pickard *et al.* 1982); however, accurate predation rates at these sites are difficult to determine. CDFW (formerly CDFG) conducted predation studies from 1987 to 1993 at the SMSCG to determine if the structure attracts and concentrates predators. The dominant predator species at the SMSCG was striped bass, and the remains of juvenile Chinook salmon were identified in their stomach contents (Edwards *et al.* 1996, Tillman *et al.* 1996, NMFS 1997).

Avian predation on fish contributes to the loss of migrating juvenile salmonids by constraining natural and artificial production. Fish-eating birds that occur in the California Central Valley include great blue herons (*Ardea herodias*), gulls (*Larus* spp.), osprey (*Pandion haliaetus*), common mergansers (*Mergus merganser*), American white pelicans (*Pelecanus erythrorhynchos*), double-crested cormorants (*Phalacrocorax* spp.), Caspian terns (*Sterna caspia*), belted kingfishers (*Ceryle alcyon*), black-crowned night herons (*Nycticorax nycticorax*), Forster's terns (*Sterna forsteri*), hooded mergansers (*Lophodytes cucullatus*), and bald eagles

(*Haliaeetus leucocephalus*) (Stephenson and Fast 2005). These birds have high metabolic rates and require large quantities of food relative to their body size.

Mammals can also be an important source of predation on salmonids within the California Central Valley. Predators such as river otters (*Lutra canadensis*), raccoons (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and western spotted skunk (*Spilogale gracilis*) are common. Other mammals that take salmonids include: badger (*Taxidea taxus*), bobcat (*Lynx rufus*), coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), long-tailed weasel (*Mustela frenata*), mink (*Mustela vison*), mountain lion (*Felis concolor*), red fox (*Vulpes vulpes*), and ringtail (*Bassariscus astutus*). These animals, especially river otters, are capable of removing large numbers of salmon and trout from the aquatic habitat (Dolloff 1993). Mammals have the potential to consume large numbers of salmonids, but generally scavenge post-spawned salmon. In the marine environment, pinnipeds, including harbor seals (*Phoca vitulina*), California sea lions (*Zalophus californianus*), and Steller's sea lions (*Eumetopia jubatus*) are the primary marine mammals preying on salmonids (Spence *et al*. 1996). Pacific striped dolphin (*Lagenorhynchus obliquidens*) and killer whale (*Orcinus orca*) can also prey on adult salmonids in the nearshore marine environment, and at times become locally important. Although harbor seal and sea lion predation primarily is confined to the marine and estuarine environments, they are known to travel well into freshwater after migrating fish and have frequently been encountered in the Delta and the lower portions of the Sacramento and San Joaquin rivers. All of these predators are opportunists, searching out locations where juveniles and adults are most vulnerable, such as the large water diversions in the south Delta.

9. Environmental Variation

Natural changes in the freshwater and marine environments play a major role in salmonid abundance. Recent evidence suggests that marine survival among salmonids fluctuates in response to 20- to 30-year cycles of climatic conditions and ocean productivity (Hare *et al*. 1999, Mantua and Hare 2002). This phenomenon has been referred to as the Pacific Decadal Oscillation. In addition, large-scale climatic regime shifts, such as the El Niño condition, appear to change productivity levels over large expanses of the Pacific Ocean. A further confounding effect is the fluctuation between drought and wet conditions in the basins of the American west. During the first part of the 1990s, much of the Pacific Coast was subject to a series of very dry years, which reduced inflows to watersheds up and down the west coast.

"El Niño" is an environmental condition often cited as a cause for the decline of West Coast salmonids (NMFS 1996b). El Niño is an unusual warming of the Pacific Ocean off South America and is caused by atmospheric changes in the tropical Pacific Ocean (Southern Oscillation-ENSO) resulting in reductions or reversals of the normal trade wind circulation patterns. The El Niño ocean conditions are characterized by anomalous warm sea surface temperatures and changes to coastal currents and upwelling patterns. Principal ecosystem alterations include decreased primary and secondary productivity in affected regions and changes in prey and predator species distributions. Cold-water species are displaced towards higher latitudes or move into deeper, cooler water, and their habitat niches occupied by species tolerant of warmer water that move upwards from the lower latitudes with the warm water tongue.

A key factor affecting many West Coast stocks has been a general 30-year decline in ocean productivity. The mechanism whereby stocks are affected is not well understood, partially because the pattern of response to these changing ocean conditions has differed among stocks, presumably due to differences in their ocean timing and distribution. It is presumed that survival in the ocean is driven largely by events occurring between ocean entry and recruitment to a sub-adult life stage.

10. Ecosystem Restoration

a. *California Bay-Delta Authority (CBDA)*

Two programs included under CBDA; the Ecosystem Restoration Program (ERP) and the Environmental Water Program (EWP), were created to improve conditions for fish, including listed salmonids, in the Central Valley (CALFED 2000). Restoration actions implemented by the ERP include the installation of fish screens, modification of barriers to improve fish passage, habitat acquisition, and instream habitat restoration. The majority of these actions address key factors affecting listed salmonids and emphasis has been placed in tributary drainages with high potential for steelhead and spring-run Chinook salmon production. Additional ongoing actions include new efforts to enhance fisheries monitoring and directly support salmonid production through hatchery releases. Recent habitat restoration initiatives sponsored and funded primarily by the ERP Program have resulted in plans to restore ecological function to 9,543 acres of shallow-water tidal and marsh habitats within the Delta. Restoration of these areas primarily involves flooding lands previously used for agriculture, thereby creating additional rearing habitat for juvenile salmonids. Similar habitat restoration is imminent adjacent to Suisun Marsh (*i.e.*, at the confluence of Montezuma Slough and the Sacramento River) as part of the Montezuma Wetlands project, which is intended to provide for commercial disposal of material dredged from San Francisco Bay in conjunction with tidal wetland restoration.

The Reasonable and Prudent Action developed within the 2009 NMFS biological opinion on the Long-term Operations of the CVP and SWP is designed to minimize or remove the adverse impacts associated with many of the project related stressors (NMFS 2009a). Within the Delta, stressors such as the DCC gates and export operations have been modified to reduce the hydraulic changes created by the project operations. Earlier closures of the DCC gates prevent early emigrating listed salmonids from entering the Delta interior through the open DCC gates. Management of the Old and Middle river flows prevents an excessive amount of negative flow towards the export facilities from occurring in the channels of Old and Middle river. When flows are negative, water moves in the opposite direction than would occur naturally, drawing fish into the south Delta and towards the export facilities or delaying their migration through the system.

In 2010, the California legislature created the Delta Stewardship Council made up of diverse community representatives and water interests. The Delta Stewardship Council is the successor to the CBDA and CALFED Bay-Delta Program. The Delta Stewardship Council adopted a comprehensive management plan for the Sacramento-San Joaquin Delta, called “The Delta Plan” on May 16, 2013, which became effective with legally-enforceable regulations on September 1, 2013 (Delta Reform Act 2009; http://deltacouncil.ca.gov/delta-plan-0).

b. *Central Valley Project Improvement Act*

The CVPIA, implemented in 1992, requires that fish and wildlife get equal consideration with other demands for water allocations derived from the CVP. From this act arose several programs that have benefited listed salmonids: the AFRP, the Anadromous Fish Screen Program (AFSP), and the Water Acquisition Program (WAP). The AFRP is engaged in monitoring, education, and restoration projects geared toward recovery of all anadromous fish species residing in the Central Valley. Restoration projects funded through the AFRP include fish passage, fish screening, riparian easement and land acquisition, development of watershed planning groups, instream and riparian habitat improvement, and gravel replenishment. The AFSP combines Federal funding with State and private funds to prioritize and construct fish screens on major water diversions mainly in the upper Sacramento River. The goal of the WAP is to acquire water supplies to meet the habitat restoration and enhancement goals of the CVPIA and to improve the DOI's ability to meet regulatory water quality requirements. Water has been used successfully to improve fish habitat for spring-run Chinook salmon and steelhead by maintaining or increasing instream flows in Butte and Mill Creeks and the San Joaquin River at critical times.

c. *Iron Mountain Mine Remediation*

Environmental Protection Agency's Iron Mountain Mine remediation involves the removal of toxic metals in acidic mine drainage from the Spring Creek Watershed with a state-of-the-art lime neutralization plant. Contaminant loading into the Sacramento River from Iron Mountain Mine has shown measurable reductions since the early 1990s (Reclamation 2004). Decreasing the heavy metal contaminants that enter the Sacramento River should increase the survival of salmonid eggs and juveniles. However, during periods of heavy rainfall upstream of the Iron Mountain Mine, Reclamation substantially increases Sacramento River flows in order to dilute heavy metal contaminants being spilled from the Spring Creek debris dam. This rapid change in flows can cause juvenile salmonids to become stranded or isolated in side channels below Keswick Dam.

d. *State Water Project Delta Pumping Plant Fish Protection Agreement (Four-Pumps Agreement)*

The Four Pumps Agreement Program has approved about $49 million for projects that benefit salmon and steelhead production in the Sacramento-San Joaquin basins and Delta since the agreement inception in 1986. Four Pumps projects that benefit spring-run Chinook salmon and steelhead include water exchange programs on Mill and Deer creeks; enhanced law enforcement efforts from San Francisco Bay upstream to the Sacramento and San Joaquin rivers and their tributaries; design and construction of fish screens and ladders on Butte Creek; and screening of diversions in Suisun Marsh and San Joaquin tributaries. Predator habitat isolation and removal, and spawning habitat enhancement projects on the San Joaquin tributaries benefit steelhead (Reclamation 2004).

11. Non-Native Invasive Species

As currently seen in the San Francisco estuary, NIS can alter the natural food webs that existed prior to their introduction. Perhaps the most significant example is illustrated by the Asiatic freshwater clams *Corbicula fluminea* and *Potamocorbula amurensis*. The arrival of these clams in the estuary disrupted the normal benthic community structure and depressed phytoplankton levels in the estuary due to the highly efficient filter feeding of the introduced clams (Cohen and Moyle 2004). The decline in the levels of phytoplankton reduces the population levels of zooplankton that feed upon them, and hence reduces the forage base available to salmonids transiting the Delta and San Francisco estuary which feed either upon the zooplankton directly or their mature forms. This lack of forage base can adversely impact the health and physiological condition of these salmonids as they emigrate through the Delta region to the Pacific Ocean.

Attempts to control the NIS also can adversely impact the health and well-being of salmonids within the affected water systems. For example, the control programs for the invasive water hyacinth (*Eichhornia crassipes*) and Brazilian waterweed (*Egeria densa*) plants in the Delta must balance the toxicity of the herbicides applied to control the plants to the probability of exposure to listed salmonids during herbicide application. In addition, the control of the nuisance plants have certain physical parameters that must be accounted for in the treatment protocols, particularly the decrease in DO resulting from the decomposing vegetable matter left by plants that have died.

12. Summary

For CV steelhead, 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. Steelhead, 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*.).

Land-use activities such as road construction, urban development, logging, mining, agriculture, and recreation are pervasive and have significantly altered fish habitat quantity and quality for Chinook salmon and steelhead through alteration of streambank and channel morphology; alteration of ambient water temperatures; degradation of water quality; elimination of spawning and rearing habitat; fragmentation of available habitats; elimination of downstream recruitment of LWM; and removal of riparian vegetation resulting in increased streambank erosion. Human-induced habitat changes, such as: alteration of natural flow regimes; installation of bank revetment; and building structures such as dams, bridges, water diversions, piers, and wharves, often provide conditions that both disorient juvenile salmonids and attract predators. Harvest activities, ocean productivity, and drought conditions provide added stressors to listed salmonid populations. In contrast, various ecosystem restoration activities have contributed to improved conditions for listed salmonids (*e.g.*, various fish screens). However, some important restoration

activities (*e.g.*, Battle Creek Restoration Project) have not yet been completed. Even in degraded reaches, spawning habitat, juvenile rearing habitat, migration corridors, and estuarine areas have a high conservation value as these functions directly affect the survival of listed salmonids.

E. Description of Viable Salmonid Population (VSP) Parameters for CV Steelhead

As an approach to determining the conservation status of salmonids, NMFS has developed a framework for identifying attributes of a VSP. The intent of this framework is to provide parties with the ability to assess the effects of management and conservation actions and ensure their actions promote the listed species' survival and recovery. This framework is known as the VSP concept (McElhany *et al*., 2000). The VSP concept measures population performance in term of four key parameters: abundance, population growth rate, spatial structure, and diversity.

Abundance

Historic CV 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). 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 Red Bluff Diversion Dam (RBDD) declined from an average of 11,187 for the period from 1967 to 1977, to an average of approximately 2,000 through the early 1990's, 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, and comprehensive steelhead population monitoring has not taken place in the Central Valley since then, despite 100 percent marking of hatchery steelhead smolts since 1998. Efforts are underway to improve this deficiency, and a long term adult escapement monitoring plan is being planned (Eilers *et al.* 2010).

Current abundance data is limited to returns to hatcheries and redd surveys conducted in a few watersheds. The hatchery data is the most reliable, as redd surveys for steelhead are often made difficult by high flows and turbid water usually present during the winter-spring spawning period.

Most of the steelhead adults returning to the Battle Creek watershed originate at the CNFH, and they constitute a significant portion of the CV steelhead DPS. The abundance of returning hatchery- and natural-origin steelhead in Battle Creek has been more reliably estimable since 2002/2003, when the first full cohort of mass marked hatchery fish returned to the CNFH, although spawning reports have occurred since 1988 (Kevin Niemela, USFWS, personal communication, 2014). Prior to 2002, hatchery and natural-origin steelhead in Battle Creek were not differentiable, and all steelhead were managed as a single, homogeneous stock, although USFWS believes the majority of returning fish in years prior to 2002 were hatchery-origin. Abundance estimates of natural-origin steelhead in Battle Creek began in 2001, although a portion of these fish were likely of hatchery-origin. USFWS data from 2001 to 2009 ranged from 222 to 545 (mean of 387, std. of 101; Figure 8; USFWS 2011). Hatchery-produced

steelhead that were 100 percent adipose-fin-clipped began returning to CNFH in 2003. The abundance of hatchery-origin steelhead returning to CNFH from 2003 to 2009 ranged from 1,004 to 3,193 (mean of 1,993, std. of 763; Figure 8; USFWS 2011). These estimates of steelhead abundance include all variants of life history types of the species *O. mykiss*, including ocean-going fish commonly referred as "steelhead" and nonanadromous types commonly referred as "rainbow trout." During recent years there has been a marked paucity of larger-sized natural-origin *O. mykiss* observed in Battle Creek (K. Niemela, USFWS, personal communication, 2010). This decline of larger-sized *O. mykiss* may indicate selection against an anadromous life history type.

Redd counts are conducted in the American River and in Clear Creek (Shasta County). An average of 154 redds have been counted on the American River from 2002-2010 (Hannon and Deason 2008, Hannon et al. 2003, Chase 2010). The Clear Creek steelhead population appears to have increased in abundance since Saeltzer Dam was removed in 2000, as the number of redds observed in surveys conducted by the USFW has steadily increased since 2001. An average of 176 redds have been counted in Clear Creek from 2003 to 2011 representing between 42 and 409 natural-origin steelhead spawning on average each year (Giovannetti et al. 2013a).

The East Bay Municipal Utilities District (EBMUD) has included steelhead in their redd surveys on the Lower Mokelumne River since the 1999-2000 spawning season. However, it is generally believed that most of the *O. mykiss* spawning in the Mokelumne River are resident fish (Satterthwaite et al. 2010), which are not part of the CV steelhead DPS.

The returns of steelhead to the Feather River Hatchery have decreased greatly over time, with only 679, 312, and 86 fish returning in 2008, 2009 and 2010, respectively. This is despite the fact that almost all of these fish are hatchery fish, suggesting that smolt and/or ocean survival was poor for these smolt classes. The average return in 2006-2010 was 649, while the average from 2001 to 2005 was 1,963. However, return data for 2011, 2012, and 2013, may indicate a rebound in numbers, with 712, 830, and 1,618 adults returning (respectively) to the hatchery (unpublished data CDWR 2014).

The years 2009 and 2010 showed poor returns of steelhead to the Feather River Hatchery and Coleman Hatchery, probably due to three consecutive drought years in 2007-2009, which would have impacted parr and smolt growth and survival in the rivers, and possibly due to poor coastal upwelling conditions in 2005 and 2006, which strongly impacted fall-run Chinook salmon post-smolt survival (Lindley et al. 2009). Natural-origin (unclipped) adult counts appear not to have decreased as greatly in those same years, based on returns to the hatcheries and redd counts conducted on Clear Creek, and the American and Mokelumne rivers. This may reflect greater fitness of naturally produced steelhead relative to hatchery fish, and certainly merits further study.

Overall, steelhead returns to hatcheries have fluctuated so much from 2001 to 2011 that no clear trend is present, other than the fact that the numbers are still far below those seen in the 1960's and 70's, and only a tiny fraction of the historical estimate. Returns of natural-origin fish are very poorly monitored, but the little data available suggest that the numbers are very small though perhaps not as variable from year to year as the hatchery returns.

***Productivit*y**

An estimated 100,000 to 300,000 naturally produced juvenile steelhead are estimated to leave the Central Valley annually, based on rough calculations from sporadic catches in trawl gear (Good *et al.* 2005). The Mossdale trawls on the San Joaquin River conducted annually by CDFW and USFWS capture steelhead smolts, although usually in very small numbers. These steelhead recoveries, which represent migrants from the Stanislaus, Tuolumne, and Merced rivers, suggest that the productivity of CV steelhead in these tributaries is very low. In addition, the Chipps Island midwater trawl dataset from the USFWS provides information on the trend (Williams *et al.* 2011).

Nobriga and Cadrett (2001) used the ratio of adipose fin-clipped (hatchery) to unclipped (natural-origin) steelhead smolt catch ratios in the Chipps Island trawl from 1998 through 2000 to estimate that about 400,000 to 700,000 steelhead smolts are produced naturally each year in the Central Valley. Good *et al.* (2005) made the following conclusion based on the Chipps Island data:

> *"If we make the fairly generous assumptions (in the sense of generating large estimates of spawners) that average fecundity is 5,000 eggs per female, 1 percent of eggs survive to reach Chipps Island, and 181,000 smolts are produced (the 1998-2000 average), about 3,628 female steelhead spawn naturally in the entire Central Valley. This can be compared with McEwan's (2001) estimate of 1 million to 2 million spawners before 1850, and 40,000 spawners in the 1960s".*

Hatcheries in the Central Valley produce approximately 1,680,000 juvenile steelhead each year. The proportion of hatchery fish in the midwater trawl exceeded 90% in 2007, 2010, and 2011 (USFWS). Because hatchery releases have been fairly consistent through the years, this data suggests that the natural production of steelhead has been declining in the Central Valley.

Spatial Structure

About 80 percent of the historical spawning and rearing habitat once used by anadromous *O. mykiss* in the Central Valley is now upstream of impassible dams (Lindley *et al.* 2006). 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 CV 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 as 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 (Latta 1977).

Steelhead appear to be well-distributed throughout the Central Valley below the major rim dams in the Sacramento River and tributaries (Good *et al.* 2005; NMFS 2011). 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.

Monitoring has detected very small numbers of steelhead in the Stanislaus, Mokelumne, and Calaveras rivers, and other streams previously thought to be devoid of steelhead (McEwan 2001). In 2012, *O. mykiss* were detected passing the Tuolumne River weir and the Stanislaus River weir (FISHBIO 2012, 2013a). In 2012, rotary screw trapping and a fish counting weir on the Merced River reported *O. mykiss* (FISHBIO 2013c). Annual Kodiak trawl surverys are conducted on the San Joaquin River at Mossdale by CDFW captured *O. mykiss* during the 2012 season (CDFW 2013). The low adult returns to the San Joaquin tributaries severely impacts CV steelhead spatial structure and further challenges the viability of the CV steelhead DPS.

Efforts to provide passage of salmonids over impassable dams have the potential to increase the spatial diversity of CV 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 and fall-run Chinook salmon. If the SJRRP is successful, habitat improved for spring-run Chinook salmon could also benefit CV steelhead (NMFS 2011).

Diversity

Genetic Diversity: CV steelhead abundance and growth rates continue to decline, which is largely the result of a significant reduction in the diversity of habitats available to these populations (Lindley *et al.* 2006). Recent reductions in population size are also supported by genetic analysis (Nielsen *et al.* 2003). Garza and Pearse (2008) analyzed the genetic relationships among CV steelhead populations and found that unlike the situation in coastal California watersheds, fish below barriers in the Central Valley were more closely related to below barrier fish from other watersheds than to *O. mykiss* above barriers in the same watershed. This pattern suggests the ancestral genetic structure is still relatively intact above barriers, but may have been altered below barriers by stock transfers.

The genetic diversity of CV steelhead is also compromised by hatchery origin fish, which likely comprise the majority of the annual spawning runs, placing the natural population at a high risk of extinction (Lindley *et al.* 2007). There are four hatcheries (Coleman National Fish Hatchery, Feather River Fish Hatchery, Nimbus Fish Hatchery, and Mokelumne River Fish Hatchery) in the Central Valley which combined release approximately 1,680,000 yearling steelhead smolts each year. These programs are intended to mitigate for the loss of steelhead habitat caused by dam construction, but hatchery origin fish now appear to constitute a major proportion of the total abundance in the DPS. Two of these hatchery stocks (Nimbus and Mokelumne River hatcheries) originated from outside the DPS (primarily from the Eel and Mad rivers) and are not presently considered part of the DPS.

Life-History Diversity: Steelhead in the Central Valley historically consisted of both summer-run and winter-run migratory forms, based on their state of sexual maturity at the time of river entry and the duration of their time in freshwater before spawning.

Between 1944 and 1947, annual counts of summer-run steelhead passing through the Old Folsom Dam fish ladder during May, June, and July ranged from 400 to 1,246 fish (Gerstung 1971). After 1950, when the fish ladder at Old Folsom Dam was destroyed by flood flows, summer-run steelhead were no longer able to access their historic spawning areas, and perished in the warm water downstream of Old Folsom Dam.

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 have been extirpated due to a lack of suitable holding and staging habitat, such as coldwater pools in the headwaters of Central Valley streams, presently located above impassible dams (Lindley *et al.* 2006).

Juvenile steelhead (parr) rear in freshwater for one to three years before migrating to the ocean as smolts (Moyle 2002). The time that parr spend in freshwater is inversely related to their growth rate, with faster-growing members of a cohort smolting at an earlier age but a smaller size (Peven *et al.* 1994; Seelbach 1993). Hallock *et al.* (1961) aged 100 adult steelhead caught in the Sacramento River upstream of the Feather River confluence in 1954, and found that 70 had smolted at age-2, 29 at age-1, and one at age-3. Seventeen of the adults were repeat spawners, with three fish on their third spawning migration, and one on its fifth. Age at first maturity varies among populations. In the Central Valley, most steelhead return to their natal streams as adults at a total age of two to four years (Hallock 1961, McEwan and Jackson 1996).

Deer and Mill creeks were monitored from 1994 to 2010 by the CDFW using rotary screw traps to capture emigrating juvenile steelhead (Johnson and Merrick 2012). Fish in the fry stage averaged 34 and 41 mm FL in Deer and Mill, respectively, while those in the parr stage averaged 115 mm FL in both streams. Silvery parr averaged 180 and 181 mm in Deer and Mill creeks, while smolts averaged 210 mm and 204 mm. Most silvery parr and smolts were caught in the spring months from March through May, while fry and parr peaked later in the spring (May and June) and were fairly common in the fall (October through December) as well.

In constrast to the upper Sacramento River tributaries, Lower American River juvenile steelhead have been shown to smolt at a very large size (270 to 350 mm FL), and nearly all smolt at age-1 (Sogard *et al.* 2012).

Summary of Viability

All indications are that natural-origin CV steelhead have continued to decrease in abundance and in the proportion of natural fish over the past 25 years (Good *et al.* 2005; NMFS 2011); the long-term trend remains negative. Hatchery production and returns are dominant over natural fish, and one of the four hatcheries is dominated by Eel/Mad River origin steelhead stock. Continued decline in the ratio between naturally produced juvenile steelhead to hatchery juvenile steelhead in fish monitoring efforts indicates that the wild population abundance is declining. Hatchery releases (100 percent adipose fin-clipped fish since 1998) have remained relatively constant over

the past decade, yet the proportion of adipose fin-clipped hatchery smolts to unclipped naturally produced smolts has steadily increased over the past several years.

Although there have been recent restoration efforts in the San Joaquin River tributaries, CV steelhead populations in the San Joaquin Basin continue to show 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 CV 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.

The widespread distribution of wild steelhead in the Central Valley provides the spatial diversity necessary for the DPS to survive and avoid localized catastrophes. However, most natural-origin CV populations are likely very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change (NMFS 2011).

The most recent status review of the CV steelhead DPS (NMFS 2011) found that the status of the population appears to have worsened since the 2005 status review (Good *et al.* 2005), when it was considered to be in danger of extinction.

IV. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species within the action area. 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).

There are several watershed restoration projects that have been implemented by the Cottonwood Creek Watershed Group as well as USFWS over the past 10 years. These projects include riparian habitat restoration, streambank stabilization, non-native vegetation control, fish passage improvement and fuels management.

Cottonwood Creek is the third largest watershed tributary west of the Sacramento River and the largest undammed tributary in the upper Sacramento River basin (CALFED 1997). The watershed is located within Shasta and Tehama counties on the north-west side of northern California's Central Valley, with a peak elevation of approximately 7,860 feet (CH2MHILL 2002, 2007) (Table 2). The lower two-thirds of the drainage lies in the Central Valley uplands, while the upstream portion includes the east slope of the North Coast Mountain Range and Klamath Mountains, and the southern slopes of the Trinity Mountains (CH2MHILL 2002). Cottonwood Creek is fed by three major branches (i.e., North, Middle, and South forks).

Table 2. Cottonwood Creek watershed characteristics

Characteristic	Value
Watershed Area	938 square miles
Cottonwood Creek Stream Length	68 miles
Headwater Elevation	7,680 feet
Mean Discharge	860 cubic feet per second (cfs)
10-year Flood	50,000 cfs
100-year Flood	93,000 cfs
Mean precipitation	36 inches

Source: CH2MHILL 2007

The Coast Range fault, Stoney Creek fault, Cold Fork fault, Sulfur Spring fault, Oak Flat fault, Battle Creek fault, and numerous cross faults and thrust faults occur in the Cottonwood Creek watershed. Fault traces located east of South Fork are likely obscured by stream activity and agricultural practices (USGS 1988; WET 1991; Dupras 1997 *as cited in* CH2MHILL 2002). The most recent fault movement is believed to have occurred more than 125,000 years ago (DWR 1992 *as cited in* CH2MHILL 2002).

Large, active landslides that contribute to the sediment discharge are abundant in the South Fork Mountain Schist of the South Fork of Cottonwood Creek (DWR 1992 *as cited in* CH2MHILL 2002) and the Rattlesnake Creek terrain of Beegum Creek (USFS 1997 *as cited in* CH2MHILL 2002). A notable slide is located on Slide Creek, tributary to the South Fork of Cottonwood Creek; in 1995 this slide contributed a large amount of sediment to South Fork Cottonwood Creek. Cottonwood Creek is a major contributor of spawning gravel to the Sacramento River (P. Bratcher, pers. comm., 2009).

The hydrology of Cottonwood Creek is typical of watersheds found along the west side of the Sacramento Valley (CH2MHILL 2002). The relatively low elevation of the watershed limits the amount of snowpack that can accumulate in any given year, which results in a hydrologic regime closely correlated to storm events (CH2MHILL 2002). Mean annual runoff in Cottonwood Creek from 1941-2000 is approximately 645,000 acre-feet (Graham Matthews and Associates 2003). Cottonwood Creek is a source of flood flow in the Sacramento River between Shasta Dam and Ord Ferry. Groundwater development is largely limited to the alluvial area near the confluence with the Sacramento River (CH2MHILL 2002).

Human impacts on Cottonwood Creek watershed began in the 1850's with gold mining operations. The gold mining in placer deposits commonly used dredge, hydraulic, and ground-sluicing techniques, resulting in the discharge of sediment to the watershed. Effects resulting from historical mining operations have generally dissipated, with the possible exception of the presence of residual mercury wastes in the tailings of historical mining sites (CH2MHILL 2007).

The Cottonwood Creek Watershed remains relatively undeveloped, and is generally characterized by tracts of harvestable timber in the upper reaches, irrigated pastureland in the middle reaches, and ranches, residential housing, and gravel mining operations in the lower

reaches. Approximately 70 percent of land within the watershed is privately owned (CH2M HILL 2002).

Fisheries and Aquatic Habitat

The Cottonwood Creek watershed continues to provide habitat for anadromous fish, including spring-run Chinook salmon and steelhead. Within the Cottonwood Creek Watershed, spring-run Chinook salmon and steelhead are known to utilize the mainstem, North Fork, Middle Fork and South Fork of Cottonwood Creek (Table 3.; CH2MHILL 2002). Environmental factors including hydrology, stream temperature, channel morphology, and gravel recruitment allow Cottonwood Creek to support significant fish populations on a seasonal and year-round basis (RMI 1987 *as cited in* CH2MHILL 2002).

Table 3. Habitat characteristics of Cottonwood Creek

Creek	Total Length (miles)	Anadromous Access (miles)	Maximum Elevation (feet)	Suitable Spawning Habitat (sq. ft.)
Mainstem	20.57	20.57	350	152,400
North Fork	28.0	20.24	5,720	37,400
Middle Fork	30.5	Unknown	7,860	36,600
South Fork	56.78	43.91	7,900	165,900

Source: CH2MHILL 2002. Data from CDFW (1978)

Steelhead

Cottonwood Creek is one of the major tributaries to the Sacramento River system that supports steelhead spawning (CH2MHILL 2002). Because they migrate during high flows, and it is difficult to distinguish juvenile steelhead from resident rainbow trout, few steelhead population estimates have been recorded in Cottonwood Creek (CH2MHILL 2002). The USFS and CDFW have observed populations of juvenile steelhead in the upper South Fork Cottonwood Creek Yolla Bolly Middle Eel Wilderness Area in the summer of 1976 (CH2MHILL 2002). Small runs of adult steelhead have been observed to migrate in the mainstem and lower reaches of the North, Middle, and South Fork Cottonwood Creek.

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

The action area provides spawning habitat for steelhead. The action area also functions as a migratory corridor for adult and juvenile steelhead, and as juvenile rearing habitat for steelhead and potentially for spring-run Chinook salmon. Due to the life history timing of CV steelhead, it is possible for one or more of the following life stages: adult migrants, spawners, incubating eggs, or rearing and emigrating juveniles to be present within the action area throughout the year.

1. Status of Species

a. *CV Steelhead*

A significant portion of the CV steelhead DPS spawn and rear in the Sacramento River and its tributaries (Reynolds, *et al*. 1993). Cottonwood Creek is one of the major tributaries to the Sacramento River system that supports steelhead spawning (CH2MHILL 2002). Because they migrate during high flows, and it is difficult to distinguish juvenile steelhead from resident rainbow trout, few steelhead population estimates have been recorded in Cottonwood Creek (CH2MHILL 2002). CDFW have observed populations of juvenile steelhead in the upper South Fork Cottonwood Creek Yolla Bolly Middle Eel Wilderness Area in the summer of 1976 (CH2MHILL 2002). Small runs of adult steelhead have been observed to migrate in the mainstem and lower reaches of the North, Middle, and South Fork Cottonwood Creek.

2. Status of Critical Habitat

The project is located within the designated Critical Habitat for the CV steelhead DPS. The action area provides key characteristics supporting the PCEs of critical habitat (*i.e.*, spawning, freshwater rearing, and freshwater migration corridors), containing adequate substrate, water quality, water quantity, water temperature, water velocity, shelter, food; riparian vegetation, space, and safe passage conditions. Habitat within the action area primarily is used as freshwater rearing and migration for juveniles and as freshwater migration for adults. The conservation value of the action area is high because it is used for extended periods of time by federally listed CV steelhead.

B. Factors affecting species and critical habitat in the action area

1. Loss of floodplain and riparian habitat and instream cover from gravel mining affecting juvenile rearing and outmigration
2. Loss of natural river morphology from gravel mining (e.g., channel braiding) affecting adult immigration, juvenile rearing and outmigration
3. Low flow conditions (i.e., low flows and flow fluctuations) associated with attraction and migratory cues affecting adult immigration, spawning and embryo incubation
4. Natural elevated water temperatures and poor water quality affecting adult immigration and holding, spawning and embryo incubation
5. Natural spawning habitat availability affecting adult spawning
6. Hammer Diversion Dam, which blocks five miles of habitat during lower flows.
7. Hammer Diversion: unscreened, potential for entrainment

C. Likelihood of species survival and recovery in the action area

The draft Central Valley Salmon and Steelhead Recovery Plan has indicated that populations of CV steelhead in the Redding area tributaries are considered “core 2” (secondary) populations. This means these watersheds have lower potential to support viable populations, due to lower abundance, or amount and quality of habitat, but that they can provide increased life history

diversity to the DPS and are likely to provide a buffering effect against local catastrophic occurrences that could affect other nearby populations.

V. EFFECTS OF THE ACTION

A. Approach to the Assessment

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 designated critical habitat. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat as defined in 50 CFR 402.02. Instead, this biological opinion relies upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat. NMFS will evaluate destruction or adverse modification of critical habitat by determining if the proposed action reduces the value of critical habitat for the conservation of the species. This biological opinion assesses the effects of the proposed Fish Passage Project on threatened CV steelhead, and CV steelhead designated critical habitat.

In the section II, "Description of the Proposed Action," of this biological opinion, NMFS provided an overview of the action. In the sections III and IV, "Status of the Species and Critical Habitat" and "Environmental Baseline," respectively, NMFS provided an overview of the threatened and endangered species and critical habitat in the action area of this consultation.

Regulations that implement section 7(a)(2) of the ESA require biological opinions 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 reduce appreciably listed species' likelihood of surviving and recovering in the wild by reducing their reproduction, numbers, or distribution (16 U.S.C. 1536; 50 CFR 402.02). Section 7 of the ESA and its implementing regulations also require biological opinions to determine if Federal actions would destroy or adversely modify the conservation value of designated critical habitat (16 U.S.C. 1536).

NMFS generally approaches "jeopardy" analyses in a series of steps. First, we evaluate the available evidence to identify the direct and indirect physical, chemical, and biotic effects of the proposed action on individual members of the listed species or aspects of the species' environment (these effects include direct, physical harm or injury to individual members of a species; modifications to something in the species' environment - such as reducing a species' prey base, enhancing populations of predators, altering spawning substrate, altering ambient temperature regimes; or adding something novel to a species' environment - such as introducing exotic competitors or noise disturbance). Once we have identified the effects of an action, we evaluate the available evidence to identify a species' probable exposure to those effects (the extent of temporal and spatial overlap between individuals of the species and the effects of the action). Once we have identified the exposure of the species to the effects of an action, we evaluate the available evidence to identify a species' probable response (including behavioral responses) to those effects to determine if those effects could 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). We then use the evidence available to determine if these reductions, if any, could reasonably be expected to appreciably reduce a species' likelihood of surviving and recovering in the wild.

The final step in conducting the "jeopardy" analysis is to consider the additive effects of the environmental baseline, the effects of the action and any reasonably foreseeable cumulative effects to determine the potential for the action to affect the survival and recovery of the species, or the conservation value of their designated critical habitat.

To evaluate the effects of the proposed action, NMFS examined USFWS's Biological Assessment, to identify likely impacts to listed anadromous salmonids within the action area, based on the best available information. In addition, there were a number of discussions on the project components with USFWS, CDFW, and a consultant from Tehama Environmental Solutions, and to make clarifications as needed (see "Consultation History" section above for more detail).

The primary information used in this assessment includes fishery information previously described in the "Status of the Species and Critical Habitat" and "Environmental Baseline" sections of this biological opinion.

B. Assessment

Using the best scientific and commercial data currently available, NMFS concurs with USFWS's determination that the proposed action is likely to adversely affect listed CV steelhead. In addition, NMFS concurs with USFWS's determination that the proposed action may affect, but is not likely to adversely affect, listed spring-run Chinook salmon. The potential for adverse effects to listed spring-run Chinook salmon are either discountable or insignificant, based on the analysis above. For these reasons, NMFS will not include discussion of effects of the proposed action on listed spring-run Chinook salmon in the following sections.

The assessment will consider the nature, duration, and extent of the effects of the proposed action relative to the migration timing, behavior, and habitat requirements of federally listed CV steelhead, and the magnitude, timing, frequency, and duration of project impacts to the species. Specifically, the assessment will consider the potential impacts related to adverse effects to CV steelhead and its habitat resulting from the Fish Passage Project. The project includes avoidance and minimization measures for the potential impacts. Due to the life history timing of CV steelhead, it is possible for one or more of the following life stages: adult migrants, or rearing and emigrating juveniles to be present within the action area throughout the year. The activities with potential adverse effects to CV steelhead include, exclusion fencing: delay in migration; blasting activities: vibration, debris; capture/relocation: stress, injury or death; sediment mobilization; riparian vegetation planting: harass; monitoring: harass; and are discussed in more detail below. Additionally, effects to critical habitat and beneficial effects are discussed in more detail below.

1. Delay in migration and avoidance of habitat

At the time proposed for the in-stream portion of the project (June through September), rearing / emigrating juveniles would be expected to potentially be in project area. Fish that may potentially be emigrating through the project reach could be impacted by delays caused by disturbance during the three-day construction period, plus a day or two more when exclusionary fences are placed. However, upstream and downstream migration at the existing structure is already very limited during the late summer / fall period when the weir boards are in place, so this potential impact is considered insignificant as it is not expected to further delay migration. Juvenile fish that may be rearing in the project area, given the time of year, will be larger and more apt, and able, to avoid the area and move to adjacent rearing habitat. General observations of fish numbers during site surveys in 2013 (TES 2014a) indicate that salmonid numbers are extremely low so impacts due to increased competition for resources if fish need to move to other areas of the stream during the very short construction period, are not expected to occur.

2. Blasting Activities

Injury or mortality could occur from ground vibration or water overpressure rises from blasting operations. Blast-induced ground vibrations, measured in inches per second (i/s), can have deleterious effects on fish embryos (fertilized eggs) at certain stages of their development. Blast-induced overpressures in water, measured in pounds per square inch (psi), can injure or kill juvenile and adult fish. Studies have shown that adult fish are less sensitive to blast-induced overpressures than juvenile fish (Kolden and Aimone-Martin 2013). A recent review of literature on the effects of blasting on salmonids indicated that the most sensitive life stage of salmonids is embryos, which begin to experience mortality at vibrations around 5.8 i/s (Kolden and Aimone-Martin 2013). This led the State of Alaska to establish a 2013 blasting standard limit of 2.0 ips for projects where salmonids are present (Timothy 2013). The shot plan prepared by CDFW indicates that a 2.0 (i/s) vibration limit could easily be attained at a distance of 80 feet from the blast source. Because no salmonid embryos are expected to be present at the time of year that blasting would occur (summer to early fall), no impacts to steelhead embryos would occur.

The same literature review found that the lowest peak overpressure to cause injury to juvenile salmonid fish was 10.0 psi which led the State of Alaska to establish a 2013 blasting standard limit of 7.3psi (Timothy 2013). CDFW conducted an analysis of the peak overpressures that would occur as a result of the proposed blasting operations along with an analysis of the setback distance required to achieve a peak overpressure of 10 psi. The result of the analysis indicated that a minimum setback distance of 69.24 feet from the blast site would be required to meet the 10 psi threshold. Installing a fish exclusion zone of at least 150 feet upstream to 150 feet downstream of the dam was determined appropriate to minimize or avoid overpressure effects. Because the at least 150-foot exclusion zone exceeds the 69.24-foot injury threshold, potential injury and / or mortality would be limited to those fish, if any, that could not feasibly by excluded. Injury or mortality could also occur from fish being hit or crushed by flying debris during the blast.

It was determined the distance debris could travel could potentially reach 500 feet in either direction. For this reason, the 150 feet buffer for vibratory concerns was increased to 500 feet in both directions. The potential for fish to be harmed due to flying debris is therefore unlikely, unless fish remain within the exclusion area. An unavoidable plume of turbidity is anticipated immediately following blasting activities as the channel immediately begins to adjust to the new conditions. This turbidity and an unknown amount of suspended sediment will likely persist in the water column for several hours until channel conditions stabilize. Turbidity and settleable matter are not expected to exceed the likely conditions in the Clean Water Act Section 401 Certification issued by the Central Valley Regional Water Quality Control Board.

If juvenile steelhead are present downstream of the dam (those that escape exclusion), it is believed that the number of fish affected will be few and most will volitionally avoid the immediate area and the concentrated plume until activities cease or turbidity diminishes. Juvenile fish outside of the 500 foot exclusion area should be able to escape any turbidity plume to available refugia downstream. Because the work will occur in the summer to early fall, no steelhead redds or incubating eggs will be affected.

3. Fish Relocation Activities

A fish exclusion zone from approximately 500 feet upstream to 500 feet downstream of the dam will be implemented prior to the onset of demolition activities. The actions necessary to remove fish out of the construction area are expected to result in some form of fish capture and handling. A permitted CDFW and / or USFWS crew will be responsible for the seining, dip-netting, and /or electroshocking. NMFS guidelines will be used if electrofishing is necessary (NMFS 2000). Any capture and handling associated with electrofishing will result in direct effects to juvenile steelhead rearing in the fish exclusion zone. It is expected that capture, handling, and release of the juvenile steelhead will disrupt normal behavior and may cause temporary stress, injury, and occasional mortality. Actions will be taken first to encourage fish to volitionally move out of the area prior to implementing other methods. It is anticipated that fish capture / relocation will not last more than one day, however additional capture / relocation will occur over several additional days if additional fish are observed within the exclusion zone as a result of daily monitoring. The fish exclusion zone will be maintained for three to four days until the blasting is completed and in-stream turbidity has dissipated. Juveniles are the only steelhead life stage expected to be in the project area at the time that capture / relocation will occur.

In creating a fish exclusion zone, a crew will walk downstream from the dam with seines, herding fish downstream out of the work area. A block net will then be set across the channel downstream of the dam. A crew will then walk upstream from the dam with seines, herding fish upstream out of the work area. A block net will then be set across the channel upstream of the project site. To remove remaining juvenile fish, snorkeling, dip-netting, and electroshocking will be used. All captured fish will be held in buckets filled with stream water for a period only long enough to transport them to an appropriate release site upstream or downstream of the project site. It is expected that, although NMFS electroshocking guidelines will be used, harm to individual fish may occur.

CDFW, in coordination with USFWS, Reclamation and Tehama Environmental Solutions, Inc, prepared a document: "Effects Analysis and Quantification of Take" to describe effects of the proposed project on CV steelhead (Bratcher 2014). The following is excerpted directly from that document:

Given the historical and anticipated current low population numbers in Cottonwood Creek watershed, and the additional limitations imposed by potential temporal flow barriers down near the confluence with mainstem Cottonwood Creek, coupled with summer water temperatures in the vicinity of the dam, low numbers of fish are anticipated to occur in the project area. However, due to the lack of field data in the project area on exact fish numbers and on South Fork Cottonwood Creek itself, two sources of data were used to assess the potential number of *O. mykiss* present in the area: (1) the fish relocation in 2007 during implementation of the Clear Creek Restoration Project, Phase 3B, when the existing channel was drained for a distance of roughly 250 meters (820 feet) (USFWS 2007a); and (2) data collected on local streams, at the same elevation, to assess fish population numbers on watersheds for recreational and other purposes (e.g. fish per mile) (pers. comm., S. Plemons, CDFW).

The Clear Creek relocation data was collected in summer 2007 during channel dewatering in the valley / alluvial portion of the creek. Fish were captured using nets and electrofishing. Seven days in July and August (three different efforts) were used to remove fish from a section of the stream that would be dewatered. Multiple trips were required because the section to be dewatered was not sealed off completely, and water leaked into the area. A total of 31steelhead (juveniles and a few adults) were relocated.

The Clear Creek data was reviewed to identify the potential number of fish that could be present on a local stream during a capture/relocation effort; one of the few steelhead examples where data could be found. It should be clearly acknowledged that this section of Clear Creek is in an alluvial, valley floor section of the watershed (compared to the Hammer Dam location, which is not alluvial), and the Clear Creek site was at a lower elevation. The redd index that year (2007) on Clear Creek was 165 (USFWS 2007b), a much higher number than what is anticipated to occur on South Fork Cottonwood at the time of the proposed project implementation (2014). Water temperatures at that time on Clear Creek were potentially lower/more suitable for salmonids at the time as well due to the water temperature regulations on Clear Creek.

According to CDFW wild trout biology staff, a number between 250 and 500 (trout) fish per mile is anticipated to occur on a stream like South Fork Cottonwood Creek. This is based upon survey information on other local streams such as Mill and Deer creeks (pers. comm. Sam Plemons, CDFW, 2014), although it should be noted that this data is typically collected at high elevations with more suitable temperatures for salmonids during the summer months. Even so, using the higher figure of 500 fish, an assumption of 1,000 feet of stream length (500 ft. in both directions from the dam) that would incur the effects of fish relocation efforts, combined with blast impacts and other direct and indirect effects, this would translate into 95 *O. mykiss* being potentially affected to an adverse level.

Using a combination of the fish affected by capture/relocation alone (31, as per Clear Creek data, despite this being a number of fish "relocated" in a similar sized area as this project's relocation

zone, plus some differences between the two sites as described above); and the impacts caused by a combination of effects, including those fish that would be in the relocation zone, the potential level of (federal ESA) take of 95 *O. mykiss* is considered to be a valid estimate.

4. Sediment mobilization

During the initial winter, and to a lesser extent for several following winters, an estimated 1,200 to 2,600 cubic yards of sediment that is currently stored upstream of the dam will be redistributed by high flows (J. Howard pers. comm.). Large amounts of sediment has the potential to negatively affect incubating eggs; the timing of the project is outside of spawning timing, which makes this a discountable effect. Additionally, although fish may also be affected by turbidity increase, because the amount of sediment is small, and mobilization will occur during high flows when background turbidity and sediment transport is relatively high, due to the active landslide located at Slides Creek upstream of the project site (Bachmann 2008), no significant affects to adult or juvenile steelhead, or steelhead redds are anticipated. The stored sediments are primarily composed of gravel and cobble, with smaller amounts of sand and finer materials (J. Howard pers. comm.). These sediments will form new bars and riffles downstream of the current dam location, which will create additional spawning and rearing habitat for salmonids.

As a result of the anticipated physical adjustments to the stream channel upstream of the current dam location, some of the woody riparian habitat that has become established along the reservoir margin will likely be lost. It is estimated that approximately 50 percent of the 0.65 acres of riparian wetland that was identified in a preliminary wetland delineation conducted for the project (TES 2014b) may be lost as a result of the lowering of the low water elevation. This will result in a temporary loss of shaded aquatic habitat. To minimize this effect, USFWS will replant a minimum of 0.33 acres of riparian vegetation.

5. Riparian Vegetation Planting

Suitable riparian vegetation will be planted on new bars that are formed downstream of the dam from the transport of coarse sediment stored behind the dam, and along the new low-water line upstream of the dam. The planting will be deferred to begin in the spring, the year after dam removal in order to allow fall and winter floods to move coarse sediment and form the new planting surfaces.

Depending on the time of year, redds and incubating eggs could be destroyed if heavy equipment is used in the stream bed, or a large staff is used to work in the area. Additionally, fish utilizing the area may become stressed and leave the area, which may make the vulnerable to predation.

Efforts will be made to minimize effects to any fish that may be present. This includes avoiding any redds in the area, using hand tools, and minimizing the number of staff involved so as to avoid disturbing fish that are nearby. The number of days to complete the plantings will also be limited to a week or less. Potential negative effects are considered insignificant, with a long term beneficial effect of improved rearing habitat.

6. Post-project Monitoring

Channel form changes will be monitored by the USFWS, annually for three years following project implementation. In addition, habitat monitoring will occur approximately the first and fifth year after project implementation to monitor fish habitat conditions. A water temperature monitor will be installed to monitor the effects of the project on stream temperatures. Also, riparian habitat upstream and downstream of the current diversion dam location will be monitored annually for three years to ensure that riparian species are establishing on new downstream bars and along the new low-water level upstream of the current diversion dam location.

These monitoring activities will help adaptively manage the site post-project, and is important information to document for future restoration efforts. Staff repeatedly returning to the site also has the potential to stress fish if occurring during spawning or fry emergence, and can injure fry or destroy redds if an appropriate monitoring protocol is not followed. Qualified staff will follow a monitoring protocol to avoid disturbing fish or habitat, and will avoid sensitive times (spawning and fry emergence), or areas adjacent to redds.

7. Affects to Critical Habitat

The stream reach in which the project is located is within the designated Critical Habitat for CV steelhead. While there will be some changes to the habitat that currently exists upstream and downstream of the dam as a result of the restoration of sediment routing, no net loss of critical habitat is expected as a result of project implementation. Turbidity generated by dam demolition activities can have an effect on the critical habitat elements that address water quality, however because 1) the impact is considered very small in quantity; 2) the project will make additional habitat accessible to fish; and 3) the project is expected to improve water quality by lowering water temperatures as a result of increased in-stream flows and decreased solar warming, the impact to this element is considered very minimal.

8. Beneficial Effects

The project is being implemented to open passage to five miles of spawning, holding and rearing habitat for CV steelhead and potentially for CV spring-run Chinook salmon. The diversion dam, as currently operated, is a complete upstream barrier to adult spring-run Chinook, with the exception of extremely high flows when fish may be able to swim around the dam, and a partial upstream barrier to adult steelhead. The dam, as it is currently operated, likely precludes, or at least inhibits, downstream emigration of adult and juvenile steelhead during the irrigation season (spring through fall). The project will allow adult spring-run Chinook to potentially access upstream areas that have favorable temperatures for holding, which could restore a small population in South Fork Cottonwood Creek. The project will allow year-round unimpeded upstream and downstream passage for steelhead, which is expected to increase steelhead populations in South Fork Cottonwood Creek and decrease potential stress, injury and mortality associated with the blockage of downstream emigration. The installation of a new screened diversion will eliminate the risk of entrainment of fish into the diversion.

The removal of the dam will also restore sediment routing through the project reach which will restore ecological processes that are expected to benefit all native fish and wildlife species. The dam removal will also likely decrease stream water temperatures in the project reach due to the fact that the shallow reservoir pool upstream of the dam currently causes a significant increase in solar heating. In addition, increased flows (2.3 cfs) in approximately 0.43 river mile of stream, downstream of the current dam will improve habitat conditions for salmonids and other native aquatic species. In total, project environmental impacts will be small relative to the expected environmental benefits. In addition, project environmental impacts will be short-term relative to the expected recurring annual environmental benefits.

VI. CUMULATIVE EFFECTS

Cumulative effects include the effects of future non-Federal (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.

These actions will occur without respect to whether the USFWS' project is implemented, and there are statutes in place to control all these activities to minimize their detrimental impacts. There are several watershed restoration projects that have been implemented by the Cottonwood Creek Watershed Group and / or the USFWS over the past approximately ten years. These projects include riparian habitat restoration, streambank stabilization, non-native vegetation control, fish passage improvement and fuels management. The Tehama County Resource Conservation District is planning a riparian and stream restoration project on Crowley Gulch, a small tributary to the main stem of Cottonwood Creek, located in the town of Cottonwood, California. The cumulative impacts of these projects and the Fish Passage Project are not anticipated to be negative, and in fact should to improve natural resource conditions for native species in the Cottonwood Creek watershed.

VII. INTEGRATION AND SYNTHESIS OF EFFECTS

The purpose of this section is to summarize the effects of the action and add those effects to the impacts described in the "Environmental Baseline" and "Cumulative Effects" sections of this biological opinion in order to inform the conclusion of whether or not the proposed action is likely to jeopardize the continued existence of the listed salmonids, or destroy or adversely modify designated critical habitat.

Populations of steelhead in California have declined drastically over the last century, and some subpopulations have been extirpated. The current status of listed salmonids within the action area, based upon their risk of extinction, has not significantly improved since the species were listed (Good *et al*. 2005). This severe decline in population over many years, and in consideration of the degraded environmental baseline, demonstrates the need for actions which will assist in the recovery of all of the ESA-listed species in the action area, and that if measures are not taken to reverse these trends, the continued existence of CV steelhead could be at risk.

A. Status of the Listed Species and Critical Habitat

1. California Central Valley steelhead

All indications are that natural-origin CV steelhead have continued to decrease in abundance and in the proportion of natural fish over the past 25 years (Good *et al.* 2005; NMFS 2011); the long-term trend remains negative. Hatchery production and returns are dominant over natural fish, and one of the four hatcheries is dominated by Eel/Mad River origin steelhead stock. Continued decline in the ratio between naturally produced juvenile steelhead to hatchery juvenile steelhead in fish monitoring efforts indicates that the wild population abundance is declining. Hatchery releases (100 percent adipose fin-clipped fish since 1998) have remained relatively constant over the past decade, yet the proportion of adipose fin-clipped hatchery smolts to unclipped naturally produced smolts has steadily increased over the past several years.

Although there have been recent restoration efforts in the San Joaquin River tributaries, CV steelhead populations in the San Joaquin Basin continue to show 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 CV 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.

The widespread distribution of wild steelhead in the Central Valley provides the spatial diversity necessary for the DPS to survive and avoid localized catastrophes. However, most natural-origin CV populations are likely very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change (NMFS 2011).

The most recent status review of the CV steelhead DPS (NMFS 2011) found that the status of the population appears to have worsened since the 2005 status review (Good *et al.* 2005), when it was considered to be in danger of extinction.

2. Designated Critical Habitat

CV steelhead - It is estimated that 80 percent of the historic spawning and rearing habitat for CV steelhead is above impassable dams as is the case for the Sacramento, Feather, Yuba, American, Mokelumne, Stanislaus, Tuolumne, Merced, and San Joaquin rivers. All critical habitat for CV steelhead occurs below impassable barriers. As such, steelhead critical habitat largely occurs in areas that historically functioned as either rearing or migratory habitats.

Critical habitat for CV steelhead is composed of PCEs that are essential for the conservation of the species including, but not limited to, spawning habitat, rearing habitat, migratory corridors, and estuarine areas. Stressors to CV steelhead PCEs include water diversions and water management, dams and other structures, loss of floodplain connectivity, loss of natural riverine function, bank protection, dredging, sediment disposal, gravel mining, invasive aquatic organisms, and agricultural, urban, and industrial land use (McEwan 2001). In the Sacramento-San Joaquin Delta, CV steelhead

critical habitat includes the Sacramento Delta Hydrological Unit as well as the San Joaquin Delta Hydrological Unit. The Sacramento-San Joaquin Delta is an ecosystem that has had dramatic habitat changes in recent years related to water quality, toxic algae blooms (e.g., Microcystis), and invasive species (e.g., the aquatic macrophyte Egeria densa). Based on the host of stressors to spawning, rearing, migratory, and estuarine habitats in the Central Valley, it is apparent that the current condition of CV steelhead critical habitat is degraded, and does not provide the conservation value necessary for the survival and recovery of the species.

B. Effects of the Proposed Action on Listed Species

Although juvenile steelhead emigration has the potential to be temporarily delayed as a result of the project, there is suitable rearing habitat upstream and downstream of the exclusion fence area. In addition, the dam currently blocks upstream migration in the summer months, and only has limited downstream migration (juveniles can drop over the dam, but may result in injury or death). For these reasons, the temporary delay during the implementation of the exclusionary fencing is considered an insignificant effect. Following dam removal, built-up sediment and increased turbidity is expected to travel downstream. Dam removal will occur during summer months; therefore impacts to incubating eggs will not occur. Since the majority of fish within 500 feet downstream will have been relocated further downstream, and fish will have ample available rearing habitat, effects of a temporary plume are considered insignificant. Sediment and woody material redistribution (from behind the dam) is expected to be a beneficial effect by increasing spawning and rearing habitat.

The impact of capture and relocation of fish within the exclusion zone has the highest likelihood to affect CV steelhead. The potential effects include stress, injury, and mortality. We expect the majority of relocated CV steelhead to experience stress from capture, but not reach the level of mortality. The exclusion zone and fish relocation, along with other best management practices, will minimize adverse effects to the maximum extent possible.

As a result of removal of the dam, an increase of available spawning, holding, and rearing habitat is expected to result, for CV steelhead. Additionally, screening the diversion will eliminate entrainment. A long-term benefit of the project is that the steelhead population in South Fork Cottonwood Creek abundance is expected to increase.

C. Impacts of the Proposed Action on DPS Survival and Potential for Recovery

Restoration, including fish passage issues, of tributaries of the upper Sacramento River was identified as a recovery action in the draft Central Valley Salmon and Steelhead Recovery Plan. The “Effects of the Action” section acknowledges and analyzes the potential effects of the Fish Passage project in South Fork Cottonwood Creek. Some potential effects of the implementation of the project are expected to result in take of listed CV steelhead in the action area, although negative effects are expected to be minimal. Most significant immediate and long-term effects of the Fish Passage Project will be to improve overall conditions for CV steelhead by increasing and improving habitat. This improvement of habitat will be achieved through increasing spawning and rearing habitat.

The adverse effects that are anticipated to result from the implementation are not the type or magnitude that would be expected to appreciably reduce the likelihood of survival and recovery of the affected species in the action area, or at the DPS level. VSP parameters of spatial structure, diversity, abundance, and productivity are not expected to be reduced; in contrast, implementing the Fish Passage Project is expected to improve these parameters, which will be necessary for the Cottonwood Creek population to maintain Core 2 status. In NMFS' opinion, the potential incremental adverse effects of the proposed project does not increase the extinction risk or jeopardize the recovery of the CV steelhead DPS. The beneficial effects are expected to contribute to the recovery of the species, by increasing the amount of spawning and rearing habitat for the DPS.

D. Impacts of the Proposed Action on Critical Habitat

Overall the Project will not diminish, but will improve and increase the conservation value of the PCEs migration corridor, spawning and rearing habitat, for CV steelhead. The immediate and long-term effects of the Fish Passage project are anticipated to be beneficial to designated critical habitat for these species.

The removal of the existing dam by blasting is likely to cause a temporary increase in turbidity and redistribution of sediment and woody material held behind the dam may deposit silt or sand into South Fork Cottonwood Creek, however, we expect this to distribute downstream during the first rains, and improve spawning and rearing habitat.

VIII. CONCLUSION

After reviewing the best scientific and commercial data available, including the current status of the listed salmonid species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is NMFS' biological opinion that the Fish Passage Project is not likely to jeopardize the continued existence of CV steelhead.

In addition, NMFS has determined that the habitat restoration action, as proposed, is not likely to destroy or adversely modify the designated critical habitat for CV 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 intended as part 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 USFWS so that they become binding conditions of any licenses issued, as appropriate, for the exemption in section 7(o)(2) to apply. USFWS has a continuing duty to regulate the activities covered by this Incidental Take Statement. If USFWS: (1) fails to assume and implement the terms and conditions; or (2) fails to require the contractors to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the license, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, USFWS must report the progress of the action and its impact on the species to NMFS as specified in this Incidental Take Statement (50 CFR §402.14(I)(3)).

A. Amount or Extent of Take

NMFS anticipates incidental take of CV steelhead through the implementation of the Fish Passage project. Specifically, NMFS anticipates that fry or juvenile steelhead may be killed, injured, or harassed during the implementation of the project.

Often, NMFS cannot, using the best available information, specifically quantify the anticipated amount of incidental take of individual listed fish because of the variability and uncertainty associated with the response of listed species to the effects of the project, the varying population size of each species, annual variations in the timing of spawning and migration, and individual habitat use within the project area.

Using best available information, we will use the estimate of 95 fish for total take of juvenile CV steelhead. However, we anticipate the actual number to be lower, due to the higher water temperatures and lower flows this year. Take may occur as stress, injury, or death due to electrofishing and handling during the relocation effort. Additionally, for any fish that remain within the exclusion zone, take may occur as harassment, injury, or death due to vibrations or flying debris during blasting. We assume that the majority (80 percent) of fish within the exclusion zone will be captured and relocated. Of these captured and relocated, based on recent CDFW studies on electrofishing steelhead (CDFG 2005-2010), we assume a small number (3 percent of each) will be injured, or killed; (1) in Table 4 below. We assume the remaining 20 percent will escape capture and remain within the exclusion zone; (2) in Table 4 below. These fish will likely be harassed at a minimum, and a small number may be susceptible to injury and mortality due to vibration impacts and flying debris during blasting activities (Table 4).

Table 4. Take of CV steelhead due to Fish Passage Project.

Take type	**Proportion of 95 fish**
(1) Capture (and relocation)	80% = 76 total fish
Stress	74% = 70
Injured	3% = 3
Killed	3% = 3
(2) Vibration and flying debris	20% = 19 total fish
Harassed	10% = 9
Injured	5% = 5
Killed	5% = 5

B. Effect of the Take

In the accompanying biological opinion, NMFS determined that this level of anticipated take is not likely to result in jeopardy to CV steelhead. In addition, NMFS determined that this level of anticipated take is not likely to result in the destruction or adverse modification of designated critical habitat for CV steelhead.

C. Reasonable and Prudent Measures

Pursuant to section 7(b)(4) of the ESA, the following reasonable and prudent measures are necessary and appropriate to minimize take of CV steelhead:

1. Due to close cooperation between USFWS, CDFW, and NMFS throughout the planning and development of the project and Biological Assessment, NMFS believes that all measures which are necessary and appropriate to minimize take of CV steelhead have already been incorporated into the project plan. Therefore, the only requirement will be that USFWS shall send a report to NMFS on the success of the riparian planting and sediment dispersal, as well as the documented take that result from the capture and relocation effort.

D. Terms and Conditions

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

1. Due to close cooperation between USFWS, CDFW, and NMFS throughout the planning and development of the project and Biological Assessment, NMFS believes that all measures which are necessary and appropriate to minimize take of CV steelhead have already been incorporated into the project plan. Therefore, the only requirement will be that USFWS shall send a report to NMFS on the success of the riparian planting and sediment dispersal, as well as the documented take that result from the capture and relocation effort.
    a. After each year of monitoring (described in the project description), USFWS shall send a report to NMFS. Any documented concerns will include recommended revisions to the monitoring plan.

Updates and reports required by these terms and conditions shall be submitted to:

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

X. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA 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" is defined in the ESA as those measures necessary to delist a species. These conservation recommendations include discretionary measures that USFWS can take to minimize or avoid adverse effects of a proposed action on a listed species or designated critical habitat or regarding the development of information. In addition to the terms and conditions of the Incidental Take Statement, NMFS provides the following conservation recommendation that will reduce or avoid adverse impacts on the listed species:

1. USFWS should continue to work together with the Cottonwood Creek Watershed Group, to identify future possible restoration actions in the watershed.

XI. REINITIATION OF CONSULTATION

This concludes formal consultation on the proposed Fish Passage project. As provided in 50 CFR §402.16, reinitiation of formal consultation is required if: (1) the amount or extent of taking specified in the incidental take statement is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the action is subsequently modified in a manner that causes an effect to the listed species that was not considered in the biological opinion; or (4) a new species is listed or critical habitat is 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.

XII. "NOT LIKELY TO ADVERSELY AFFECT" DETERMINATIONS

NMFS does not anticipate the proposed action will result in take of CV spring-run Chinook salmon. Although the potential for take is the same as description in the "Effects" section for CV steelhead, spring-run Chinook salmon are not expected to be present during the time of construction (summer months). Designated critical habitat is outside of the action area, and there is no known spring-run Chinook salmon holding or spawning habitat in South Fork Cottonwood Creek. Juveniles may be present during the cooler water temperatures and higher flows outside of the summer months. Therefore the potential for take is considered discountable.

XIII. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT CONSULTATION

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration 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 or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide

impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by the USFWS and descriptions of EFH for Pacific coast salmon (PFMC 1999) contained in the fishery management plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

A. Essential Fish Habitat Affected by the Project

Freshwater EFH for salmon consists of four major components: spawning and incubation habitat; juvenile rearing habitat; juvenile migration corridors; and adult migration corridors and adult holding habitat (Pacific Fishery Management Council 2003). Important components of EFH for spawning, rearing, and migration include suitable substrate composition; water quality (e.g., DO, nutrients, temperature); water quantity, depth and velocity; channel gradient and stability; food; cover and habitat complexity (e.g., large woody material, pools, channel complexity, aquatic vegetation); space; access and passage; and floodplain and habitat connectivity (Pacific Fishery Management Council 2003). The proposed project site is within the region identified as EFH for Pacific salmon in Amendment 14 of the Pacific Salmon FMPs.

Factors limiting salmon populations in the South Fork Cottonwood Creek Watershed include flow conditions affecting juvenile rearing and outmigration, water temperatures and water quality affecting adult immigration, holding, spawning and embryo incubation, and lack of spawning habitat due to sediment transport process being blocked by the Hammer Diversion Dam.

B. Adverse Effects on Essential Fish Habitat

Short-term adverse effects and long-term beneficial effects to EFH are described in the “Effects of the Action” section above and are generally expected to apply to Pacific salmon EFH.

C. Essential Fish Habitat Conservation Recommendations

As the adverse effects to EFH associated with the proposed project will generally occur in the critical habitat utilized by the federally listed species addressed in the enclosed biological opinion, NMFS recommends that reasonable and prudent measure number 1 and the respective implementing terms and condition as well as conservation recommendation 1 described in the enclosed biological opinion, be adopted as EFH conservation recommendations.

Based on the best available information, and upon review of the effects of the proposed Fish Passage Project, NMFS believes that the proposed action will have temporary adverse effects on EFH of Pacific salmon protected under MSA. South Fork Cottonwood Creek provides all four major components of freshwater EFH for salmon, therefore, long term effects of the Fish Passage Project are expected to include an increase in the amount of available habitat and enhance stream and riparian habitat suitability for Pacific salmon.

D. Supplemental Consultation

The USFWS must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations (50 CFR 600.920(l)).

XIV. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

The Data Quality Act (DQA) specifies three components contributing to the quality of a document. They are utility, integrity, and objectivity. This section of the opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

A. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is the USFWS. Other interested users could include the Corps and CDFW. Individual copies of this opinion were provided to the USFWS. This opinion will be posted on the Public Consultation Tracking System web site (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). The format and naming adheres to conventional standards for style.

B. Integrity

This consultation was completed on a computer system managed by NMFS in accordance with relevant information technology security policies and standards set out in Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

C. Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01, et seq., and the Magnuson-Stevens Fishery Conservation and Management Act (MSA) implementing regulations regarding Essential Fish Habitat (EFH), 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the Literature Cited. The analyses in this opinion and EFH in enclosure 2, contain more background on information sources and quality.

Referencing: All supporting materials, information, data and analyses are properly referenced, consistent with standard scientific referencing style.

Review Process: This consultation was drafted by NMFS staff with training in ESA and MSA implementation, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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