UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

Refer to NMFS ECO#: WCRO-2019-01994

September 16, 2019

Richard J. Woodley
Regional Resources Manager
Bureau of USBR
Mid-Pacific Regional Office
2800 Cottage Way
Sacramento, California 95825-1898

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, for the Lower Clear Creek Floodplain and Stream Channel Restoration project, Phase 3C

Dear Mr. Woodley:

Thank you for your letter of June 26, 2019, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to Section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Lower Clear Creek Floodplain and Stream Channel Restoration Project, Phase 3C (Project), and for your follow up final/updated biological assessment on July 28, 2019.

Based on the best available scientific and commercial information, the biological opinion concludes that the Project, is not likely to jeopardize the continued existence of the federally listed threatened Central Valley spring-run Chinook salmon evolutionarily significant unit (*Oncorhynchus tshawytscha*) or the threatened California Central Valley steelhead distinct population segment (*O. mykiss*), and is not likely to destroy or adversely modify their designated critical habitats. For the above species, NMFS has included an incidental take statement with reasonable and prudent measures and non-discretionary terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed species associated with the project.

NMFS reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)), and concluded that the action would adversely affect the EFH of Pacific Coast Salmon. Therefore, we have included the results of that review in Section 3 of this document.

Please contact Jahnava Duryea at the NMFS CCVO at (916) 930-3725 or via email at Jahnava.Duryea@noaa.gov, if you have any questions concerning this Section 7 consultation, or if you require additional information.

Sincerely,

Maria Rea
Assistant Regional Administrator
California Central Valley Office

Enclosure

cc: To the file 151422-WCR2019-SA00530
Mr. Doug Kleinsmith, Reclamation Natural Resources Specialist, dkleinsmith@usbr.gov
Mr. Sean Frische, Reclamation Clear Creek Phase 3C Project Manager, sfrische@usbr.gov

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Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

Lower Clear Creek Floodplain and Stream Channel Restoration project, Phase 3C

NMFS Consultation Number: WCRO-2019-01994

Action Agency: United States Bureau of Reclamation

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Central Valley spring-run Chinook salmon (*Oncorhynchus tshawytscha*)	Threatened	Yes	No	Yes	No
California Central Valley steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No

Fishery Management Plan That Identifies EFH in the project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	Yes

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

Issued By:

Maria Rea
Assistant Regional Administrator

Date: September 16, 2019

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LIST OF ACRONYMS

BA – biological assessment
BLM – Bureau of Land Management
BMPs – best management practices
CCV – California Central Valley
CCVO – California Central Valley Office
CDFG – California Department of Fish and Game
CDFW – California Department of Fish and Wildlife
CFR – Code of Federal Register
CFS – cubic feet per second
CNFH – Coleman National Fish Hatchery
CRR – Cohort replacement rate
CV – Central Valley
CVPIA – Central Valley Project Improvement Act
CVP – Central Valley Project
cy – cubic yards
DPS – distinct population segment
DQA – Data Quality Act
DWR – California Department of Water Resources
EFH – essential fish habitat
ESA – Endangered Species Act
ESU – evolutionarily significant unit
°F – degrees Fahrenheit
FERC – Federal Energy Regulatory Commission
FMP – Fishery Management Plan
FR – Federal Register
FRFH – Feather River Fish Hatchery
FSCRP – Lower Clear Creek Floodplain and Stream Channel Restoration Project
HAPC – habitat area of particular concern
ITS – incidental take statement
LCC – Lower Clear Creek
MSA – Magnuson-Stevens Fishery Conservation and Management Act
msl – mean sea level
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration
NTUs – Nephelometric Turbidity Units
OHWM – ordinary high water mark
opinion – biological opinion
PBF – physical and biological features
PCE – primary constituent elements
PVA – population viability analysis
RBDD – Red Bluff Diversion Dam
RCD – Resource Conservation Districts
RM – river mile
SJRRP – San Joaquin River Restoration Project
SPCCP – spill prevention, control, and counter-measure plan

SRA – shaded riverine aquatic
SWE – snow water equivalent
SWP – State Water Project
SWPPP – storm water pollution prevention plan
TAC – technical advisory committee
T&C – term and condition
USACE – United States Army Corps of Engineers
USFWS – United States Fish and Wildlife Service
VSP – viable salmonid population

1. INTRODUCTION

This Introduction section provides information relevant to the other sections of this document and is incorporated by reference into Sections 2 and 3 below.

1.1 Background

NOAA's National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with Section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR § 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR § 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). A complete record of this consultation is on file at NMFS' California Central Valley Office (CCVO).

1.2 Consultation History

- From July 7 – September 25, 2017, email correspondences between Alexandra Woodward from the U.S. Bureau of USBR (USBR) and Naseem Alston (NMFS) to establish a point of contact, inform NMFS of the upcoming consultation, and coordinate on in-water work windows. In 2017, USBR had several discussions with U.S. Fish and Wildlife Service (USFWS) regarding the project and the potential effects to listed species.

- On November 8, 2017, NMFS CCVO received a consultation initiation request and biological assessment (BA) from USBR for the Lower Clear Creek Floodplain and Stream Channel Restoration Project, Phase 3C (LCC FSCRP).

- On March 8, 2018, NMFS project biologist, Jahnava Duryea, received an email from Alexandra Woodward requesting that NMFS hold off on completing consultation until further notice due to potential adjustments to the design and United States Army Corps of Engineers (USACE) permitting issues.

- On March 13, 2018, USBR hosted a field trip to the Phase 3C restoration site. Representatives from USBR, U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), California Department of Fish and Wildlife (CDFW), USACE, the State Water Board, and Yurok tribe contractors were in attendance to discuss USACE permitting requirements and potential design adjustments.

- On July 3, 2018, the consultation was officially withdrawn due to inactivity of formal consultation and by request of USBR until USACE permitting issues were resolved and corresponding design modifications to the projects have been satisfactorily addressed in a new environmental assessment (EA).
- On June 26, 2019, NMFS CCVO received a letter from Reclamation requesting initiation of consultation.
- On July 28, 2019, NMFS CCVO received the updated final BA from Reclamation for the Project, and initiated consultation.

1.3 Proposed Federal Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR § 402.02). Reclamation and the U.S. Fish and Wildlife Service are providing funds to implement the Project as directed under the Central Valley Project Improvement Act (CVPIA) (Title 34 of Public Law 102-575, Section 3406.(b)(12)). The USACE is a cooperating agency as they will issue a Clean Water Act Section 404 permit for this Project. Reclamation is the designated lead Federal action agency for this consultation. The Central Valley (CV) Water Board will issue a Clean Water Act Section 401 permit for the Project, and therefore is the lead State action agency.

As co-lead Federal action agencies, Reclamation and BLM, propose to restore the natural floodplain and realign the stream channel of a 0.7 mile reach of lower Clear Creek that has been severely degraded by gravel extraction activities and by blockage of bedload by Whiskeytown Dam. Rehabilitation of natural stream channel and floodplain morphology is expected to improve rearing habitat for fry and juvenile salmonids, reduce fish stranding, and improve fish passage.

"Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR § 402.02). There are no interrelated or interdependent actions associated with the proposed action.

1.3.1 Project Location

The project is located in the southwest portion of the City of Redding, Shasta County, California, approximately 3.5 miles west of Interstate 5. The project is also within the BLM Clear Creek Greenway located between the Gold Dredge Trailhead and the China Garden Trailhead off Clear Creek Road (Figure 1). The project is bordered on the north by Clear Creek Road and on the south by Clear Creek and the adjacent bluffs. The majority of work will occur below the ordinary high water mark (OHWM) of lower Clear Creek between approximately river mile (RM) 2.1 and 2.8. The entire action area is on BLM property.

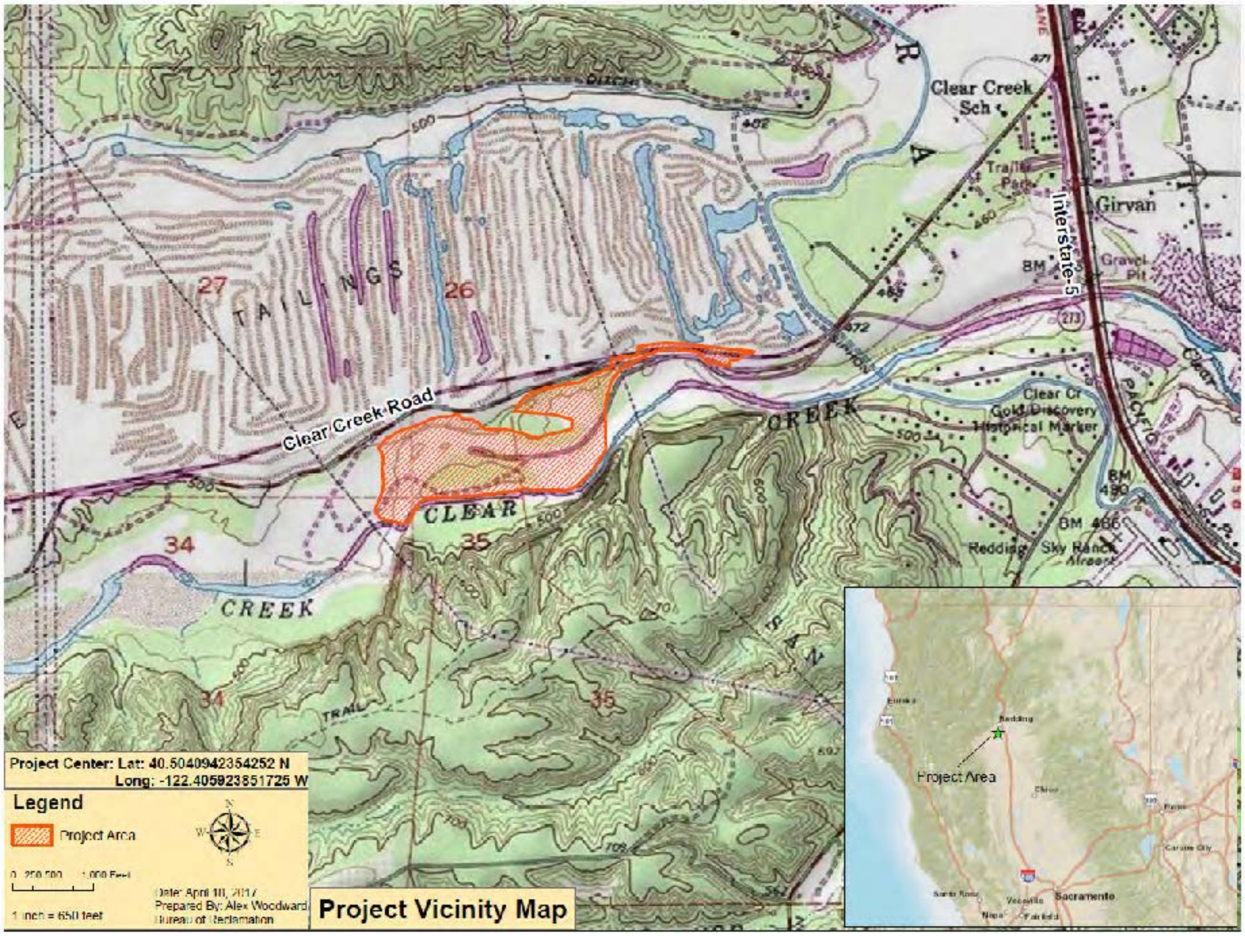

Figure 1. Map of the Lower Clear Creek Floodplain and Stream Channel Restoration Project location and vicinity.

1.3.2 Project Description

Phase 3C is the final, downstream phase of the Project described in the Clear Creek Conceptual Plan (McBain & Trush et al. 1999a) and Clear Creek Technical and Design Document (McBain & Trush et al. 1999b). The primary goals of the proposed Project are to improve salmonid rearing habitat, reduce fish stranding, and improve fish passage. While other stream channel restoration projects have been proposed and undertaken in Clear Creek, the proposed Project would focus on a two-mile reach heavily degraded by human impacts, including extensive gold and gravel mining and blockage of bedload and sediment by Whiskeytown Dam.

The components of the proposed action are to construct a channel plug and excavate a new channel alignment along this reach of lower Clear Creek, similar to where the channel historically occurred prior to gravel mining. Re-alignment of the stream channel to the historic alignment would lengthen the channel, increase sinuosity, and establish a more complex channel to provide the necessary depth and suitable water temperatures for adult migration. The Project would enhance fish and wildlife habitat, restore native vegetation, and improve the connectivity of this portion of lower Clear Creek to its historic floodplain.

The primary design elements include a variety of islands, riffles, side channels, backwater alcoves, large wood habitat features, wetland enhancements, floodplain complexes, and restored riparian surfaces. Channel splits would increase shoreline area for fry habitat and the creation of additional channels and alcoves inundated at 200 cubic feet per second (cfs) will expand rearing habitat at frequent flows. Creation of an off-channel pond will increase off-channel rearing habitat, expand seasonal wetlands, and increase emergent and wetland vegetation. Designing floodplain surfaces at suitable elevations will increase natural recruitment of cottonwoods and

More specifically, the proposed action would:

- Increase the length of the Clear Creek channel by 600 linear feet and decrease the channel slope. Flows are expected to overtop banks in this reach at less than 2,000 cfs, which would improve floodplain function, reduces the risk of channel incision, and prevents the development of a head cut that could migrate upstream towards existing restoration sites. The proposed channel is designed to have at least 0.9 feet of flow depth at 100 cfs for adult fish passage.

- Improve functional value of existing flow regime to native fish and wildlife species by restoring river-floodplain connectivity and creating suitable off-channel habitat.

- Restore the action area floodplain, which would lead to increased channel complexity and sinuosity that would result in better water quality and habitat throughout the reach.

- Restore riparian vegetation to shade the flows that flood the action area and reduce water temperatures.

- Remove invasive plants in the action area, substantially reducing or eliminating the contributions of this ecological stressor of the downstream environment.

The proposed action would result in temporary physical disturbance to a total area of 17.8 acres and permanent disturbance to 27.3 acres. Of these acreages, 4.4 acres are temporary disturbances to riparian habitat and 7.2 area permanent disturbances to riparian habitat. The temporary ground disturbance area will be re-contoured to pre-project condition and revegetated with native species upon project completion. A total of 9.9 acres of riparian habitat would be replanted. Although the floodplain earthwork areas will be contoured to a different grade from pre-project conditions, they will be revegetated with native plant species, with an emphasis on riparian plants.

The majority of disturbance (e.g., new channel creation, floodplain fill and revegetation, stream crossings, log jam installation, and the primary stage, stockpile, processing area) is located below the OHWM of Clear Creek. The area consists of a pond, Clear Creek, and a variety of vegetation communities such as Fremont cottonwood-willow, willow-blackberry, valley oak woodland alliance, arroyo willow thickets alliance, upland mustards/annual brome grasslands, and gray pine/white leaf manzanita (California Natural Diversity Database, accessed on 22 July 2019). Revegetation and planting efforts will start during construction and may continue until early spring the following year. The revegetation will be monitored and maintained for ten years following implementation to ensure long term success. Revegetation and planting efforts would occur in the fall or winter immediately after construction concludes. If weather and flows make it difficult to finish revegetation efforts, then they will resume and finish the following fall. This monitoring period will also be used to minimize and control the spread of non-native invasive plants. More details on specific revegetation efforts and standards, and monitoring methods will be detailed in a separate Revegetation and Monitoring Plan.

Access roads necessary for ongoing monitoring of revegetated sites will be left open until no longer needed, or until the 10-year monitoring and maintenance period ends. These access roads will ultimately be seeded or covered with jute matting to provide erosion control between monitoring years. Selected areas may be planted to minimize forest fragmentation. Access across the new channel alignment to these sites to monitor restoration success will occur via boat and foot. The stream crossing (see feature C-50 on Figure 2) may be used for heavy equipment access if post-project monitoring indicates a need. The location of the stream crossing may shift slightly due to channel adjustments and site evolution.

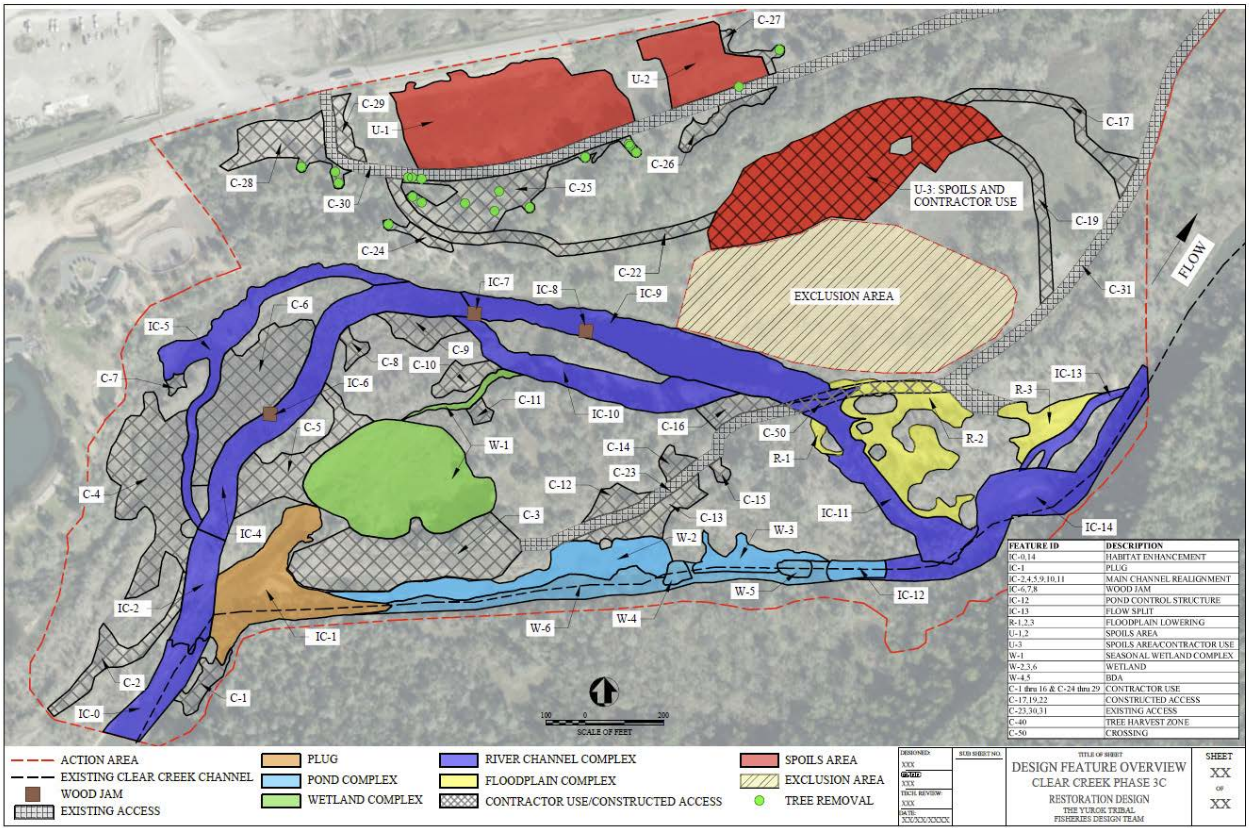

Figure 2. Project activity area map.

The proposed action consists of the following components:

(1) Site preparation (*i.e.*, access, standing water removal and discharge)

(2) Fish relocation

(3) Access roads/creek crossings

(4) Staging, stockpiling, and materials processing

(5) Channel creation and floodplain fill

(6) Reinforced bank and log jam control feature

(7) Revegetation and habitat restoration

1.3.2.1 Site Preparation

Prior to construction, the work zones will be clearly marked, fenced, or flagged. In addition, sensitive areas within, or near, the designated work zone will also be indicated on the project plans as exclusion zones and clearly marked in the field with high-visibility fencing or flagging adequate to prevent accidental entry. Work boundary markers will be maintained throughout construction activities. Site preparation would include the following activities:

- *Site Access* – Access to the Project site from Clear Creek Road is an existing dirt road that connects to the China Garden trail, west of the public entrance (Figure 2). Access throughout the work areas in the creek and floodplain will be limited to access routes and contractor use areas shown in Figure 2. Project access areas may also be cleared of vegetation and will be re-graded as part of the floodplain earthwork activities and subsequently revegetated. Existing roads are approximately 12 feet wide and may need to be reinforced or widened up to 30 feet in selected areas to be used as haul roads. Most access roads will remain unchanged in width except in areas where there will be congested truck hauling activities. These areas will be widened as needed (up to 30 feet) or strategic pull-out areas will be developed for passing purposes. At a minimum, access roads will be graded to match natural conditions, seeded, and mulched following construction. Selected portions of access roads may be planted to minimize forest fragmentation. Equipment required for this activity may include: excavator (1); dozer (1); articulating end dump (1); water truck (1); motor grader (1); crane (1); and hand tools.

- *Vegetation Clearing and Grubbing* – Prior to construction all work areas will be cleared, grubbed, and trimmed. Vegetation removal is anticipated to be complete within a month. Mature riparian trees vary in size by species and are generally characterized as greater than 35 feet tall or six to eight inches in diameter at breast height. Mature riparian trees will be avoided to help maintain diverse riparian structure. A variety of grasses, shrubs, vines, willows, young riparian trees (no more than two to three inches diameter at breast height), and pine trees would be cleared from project work areas, and either repurposed for in-water habitat structures or disposed of off-site. Suitable materials (including desirable willow cuttings and clumps) will be integrated into wood structures. Grubbing would occur six inches down into surficial material. Trimming along the existing access road from Clear Creek Road is not anticipated. Equipment required for this activity may include: excavator or backhoe (2); water truck (1); motor grader (1); and hand tools.

- *In-Water Activity Isolation* and *Turbidity Management* – In-water activities are those that occur in the wetted portion of the channel. These activities, such as dredging silt from the pond, construction of the proposed channel alignment, creation of new alcoves, and of the log jam will be isolated from flowing waters of Clear Creek. Isolation of activities will be accomplished by constructing diversion berms and installing turbidity curtains around the activity areas. These components could consist of k-rails covered with a plastic liner, or berms of spawning gravel with a turbidity curtain. Heavy equipment will be used to place isolation components and perform the necessary earthwork. Prior to any activities in the backwater channel, qualified biologists will survey for salmonids and relocate them.

Once the pond and backwater channel are fully isolated from the flows of Clear Creek and fish rescues are complete, the contractor may pump standing water down by approximately three feet from the backwater channel and pond with a three- to six-inch pipe through a filter. Water will either be pumped to water trucks to be used for dust abatement onsite or discharged to a settling basin excavated on-site to allow infiltration or evaporation. The settling basin would be located east of the existing pond, at least 50 feet away from the main Clear Creek channel, and pumping velocities will be adjusted to ensure discharge does not exceed infiltration or evaporation. The intake pump would be placed further away from the shore, and would be covered with a screen following NMFS's 1997 Fish Screening Criteria for Anadromous Salmonids. The screen slots would be ¼-inch and the intake pump would be covered with a velocity reducing perforated drum to further prevent debris and aquatic organisms from entering the pump system.

Surface runoff into water bodies will not be allowed. A berm and silt fence will be constructed around the settling basin to ensure no runoff water discharges into waters of the U.S. The settling basin will be located within the footprint of the proposed channel alignment; therefore, settled sediments will eventually be excavated during channel creation, and the area may be covered with native material 2.5 to 5 inches in diameter.

Upon completion of an in-water activity, the turbidity curtains and diversion berms isolating the activity from the flowing waters of Clear Creek will be removed gradually starting with the downstream end, providing time for inundation, and then, followed by inundation from the upstream end. Turbidity discharges resulting from project activities will be monitored to ensure that turbidity (measured in Nephelometric Turbidity Units or NTUs) does not exceed Central Valley Regional Water Quality Control Board 401 general water quality certification. Equipment required for this activity may include a dozer, excavator, and hand tools.

- *Dewatering and Discharge* – Standing water may be present in the pond complex (current creek channel). The pond is approximately 950 feet-long by 120 feet-wide, and nine feet deep at its deepest point. The backwater channel may contain a few inches to a foot of water but is anticipated to naturally be disconnected from the main creek channel during initial construction (Figure 3). Flows during the construction season (July or August) are typically around 150 cfs. The existing pond and adjacent wetland areas on the north side of the project site disconnect from the Clear Creek channel between 500 and 1,000 cfs. Thus, the upstream end of the pond and wetland areas are expected to be naturally disconnected from the main channel. The downstream end of the pond may stay connected to Clear Creek channel longer due to runoff from the north valley wall and elevated groundwater levels. The downstream end of the pond will be isolated from the flowing water of Clear Creek using techniques described in the previous section.

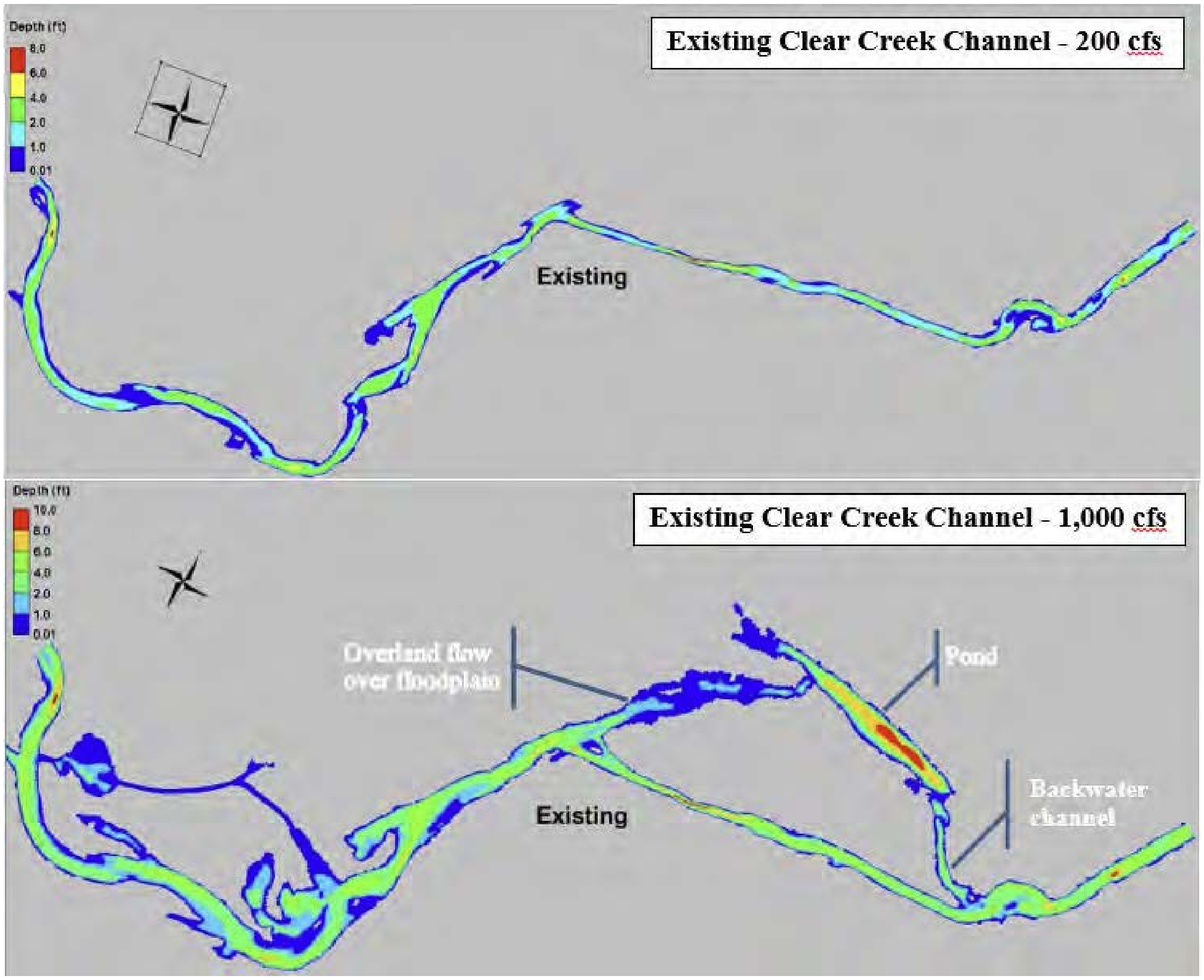

Figure 3**.** Depth color map showing the path of water in the existing Phase 3C section of the Clear Creek channel, the pond, and backwater channel at flows of 200 cfs compared to 1,000 cfs. The pond and backwater channel start to receive flows and connect to the main creek channel between 500 and 1,000 cfs.

1.3.2.2 Fish Relocation

Prior to dewatering or construction of the stream crossing, the pond and backwater channel will be surveyed by a qualified biologist to identify and relocate any native fishes (i.e. salmonids, Sacramento Sucker, Riffle Sculpin, Western Brook Lamprey, etc.) that may be present. Fish rescue and relocation operations will occur after these areas are isolated from the flowing channel and prior to pumping of ponded water or construction activities. Fish biologists will implement fish rescue operations under an existing ESA Section 10 permit for Clear Creek Fish Restoration Program Monitoring, through the use of seining, or electrofishing if necessary. Use of seine nets may not be feasible in the backwater channel due to dense vegetation, and electrofishing may be necessary. Seining will be the preferred procedure, however, if electrofishing is deemed appropriate and necessary for the efficient and successful removal of fishes, the NMFS electrofishing guidelines (NMFS 2000) will be strictly followed. The most appropriate method of rescuing and relocating stranded fishes from areas to be dewatered will be determined by fish biologists.

The fish rescue team will be comprised of qualified fishery biologists with professional experience using seines and electrofishing equipment. Up to two fish rescue teams of two to four persons will be used to facilitate efficient fish removal, reduce handling time, lower physiological stress, and reduce potential mortality rates. If electrofishing is employed, a minimum of three passes through each stranding location will be conducted until all fish are removed. Captured juvenile fishes will be placed in five-gallon buckets and segregated by size class throughout captivity. At the end of each pass, captured fishes will be transferred into buckets with aerated water or into in-river holding tanks (i.e., buckets with small holes allowing freshwater infiltration). After fishes are fully recovered, they will be released to the main channel of lower Clear Creek. All captured adult fishes will be placed in appropriately-sized containers and immediately transported and released to the main channel of lower Clear Creek channel.

All rescued fishes will be counted, measured, and recorded by species. The number and run-type of Chinook salmon and steelhead captured, and the number of fish accidentally killed prior to release, will be reported to NMFS and CDFW. Non-native, invasive fish species, such as bass and sunfish, and turtles such as red-eared sliders that are captured will be removed. This will benefit salmonids and pond turtles due to a reduction in competition and predators.

1.3.2.3 Tree Harvest

A total of 19 pine trees were selected for harvest in Contractor Use areas by BLM staff in coordination with Reclamation for Project use. These trees are distributed in contractor use areas C-24, C-25, C-27, C-28, and C-30 (Figure 2). Tree harvest includes removal of the entire tree, including the rootwad. After each rootwad is removed, the area would be filled in and packed down. Additionally, trees would be harvested off-site through agreements with federal land management agencies and private landowners.

1.3.2.4 Staging, Stockpiling, and Materials Processing

Staging of equipment, stockpiling and processing of material, and stockpiling of any excess material would occur within the Primary Stage, Stockpile, Processing Area. The majority of the Primary Stage, Stockpile, Processing Area, where excavated material would be sorted and stockpiled until reused for the Project or hauled offsite, would be located below the OHWM. However, this area does not activate with flows normally present during July through September (i.e., activates at 1,000 cfs). Based on expected conditions, approximately 20 percent of construction activities would occur in-water. This would involve a total of approximately 6,000 cy of wet excavation, and approximately 10,340 cy of in-water fill, which could increase turbidity and suspended sediment levels in lower Clear Creek. The 80 percent of work that would not be in-water involves approximately 38,000 cy of excavation and 34,260 cy of fill and topsoil replacement.

There would be a total of up to approximately 34,590 cubic yards (cy) of spoils stockpiled in the upland spoils area (U-1, U-2, U-3 in Figure 2). Material processing operations would also occur within the proposed Primary Stage, Stockpile, Processing Area to sort out fines from coarse materials. Fines separated from excavated material would be reused throughout the Project site for the creation of riffles, proposed channel, to fill low points in the floodplain area, and to support revegetation efforts. Coarser substrate material will be used to fill portions of the pond and to construct the riffles. The remaining spoils material would be spread across the stockpile area and seeded upon Project completion.

1.3.2.5 Channel Creation and Floodplain Fill

Excavation depth at the upstream transition to the new channel was designed to create the desired channel capacity and longitudinal slope. The existing pond at this point would be filled to match the upstream gradient of channel invert. Currently there is an active beaver dam on the eastern end of the pond, which would be removed as the channel is constructed through the pond and split into two smaller channels before it reconnects with the existing creek downstream. Splitting the creek into two smaller channels will increase shoreline area for fry habitat. Equipment required for this activity may include: loaders (2); excavators (4); articulating end dumps (2); dump trucks (3); crane (1); and dozers (2).

Prior to excavation of the new channel alignment, diversion berms and turbidity curtains will be installed around the proposed upstream and downstream connections to the existing channel in order to isolate the work and prevent turbidity impacts. Upon completion of excavation of the new channel alignment, the turbidity curtains and diversion berms isolating the new channel from the main stem will be removed gradually starting with the downstream end, providing time for inundation, and then followed by the upstream inlet. Turbidity will be monitored to make sure it does not exceed 10 percent of background turbidity levels as measured upstream.

The existing channel alignment would be left as is (not filled), with the exception of a porous plug of large rock and wood constructed at its upstream end to redirect Clear Creek flows to the new channel, while still allowing hyporheic flow through to what will become a backwater area. Figure 4 shows how the old channel becomes inundated as a backwater channel once the proposed channel alignment is constructed. The old channel starts to inundate as a backwater channel at approximately 100 cfs. Additionally, two alcoves would be created through excavation work on the north bank of the existing channel and vegetated with emergent and riparian plants. These features were designed to provide slow water areas for rearing habitat. Water from the downstream Clear Creek connection and the upstream hyporheic connection starts to inundate these alcoves at approximately 1,000 cfs.

Rootwads and large wood that would be removed from this Project and other areas already permitted for obtaining rootwads, would be reused and anchored throughout the proposed channel alignment to provide additional rearing habitat for salmonid fry and juveniles. As-built, the Project will result in an increase of Clear Creek channel by 600 linear feet due to the longer alignment of the new channel and the maintenance of the current channel as a backwater area at higher flows.

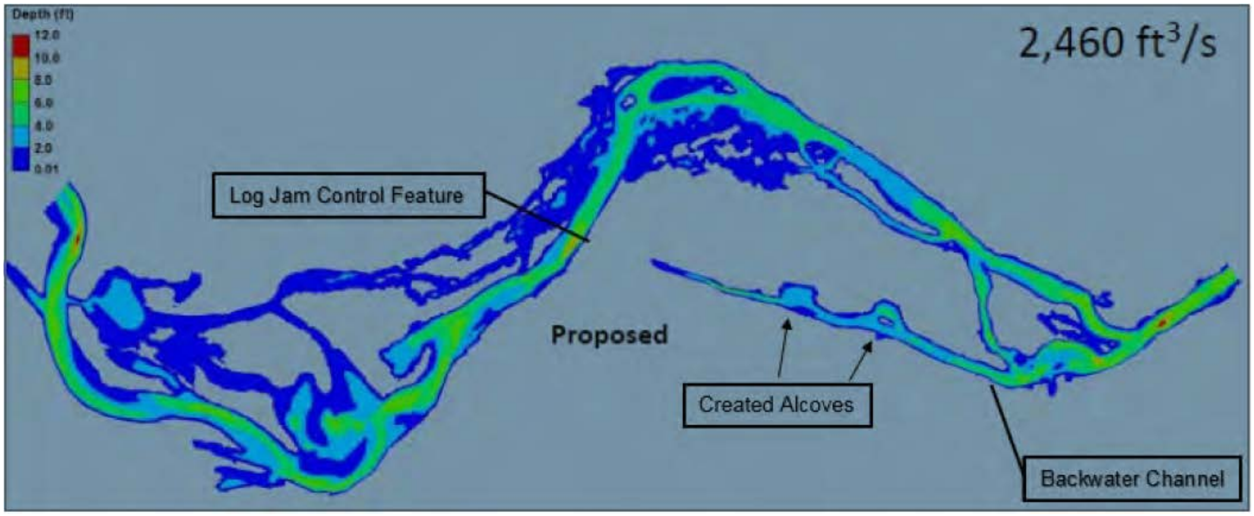

Figure 4. Proposed channel alignment inundation at 2,460 cfs.

1.3.2.6 Reinforced Bank and Control Feature

A control feature (*i.e.*, a porous channel plug) would be constructed in the existing channel to discourage restoration of flows into the existing channel, and to maintain flow through the proposed channel. This would be done with a log jam consisting of large rock and wood, comparable to a landslide blocking a channel. Coarse material would be used to maintain hyporheic flow to the existing channel that will be converted to a backflow area at higher flows. The overflow channel will be activated when flows exceed the 2- to 5-year flood, which will flush out organics and provide oxygenated water through the backflow area. Anticipated list of equipment: tractor trailer (2); excavator (1); dozer (1); loader (1); grizzle screen (1); hand tools.

1.3.2.7 Revegetation and Habitat Restoration

A separate *Revegetation and Monitoring Plan* will be prepared by Reclamation and BLM, then submitted to USFWS for approval. The priorities for revegetation and habitat restoration are preserving existing mature vegetation, planting large trees that grow quickly, and providing hydrology to riparian areas. Revegetation with native plant species would occur throughout the project site including areas of floodplain earthwork, staging and stockpile, as well as the perimeters of the proposed channel and alcoves. Additional planting of riparian and herbaceous plant understory species would occur throughout the project site to increase habitat for aquatic species, birds, and other wildlife. Predicted water surface elevation at flows of 1,000 cfs was used as the guideline for the riparian zone. Riparian plants would be a combination of vine, shrub, and tree species, planted as cuttings or container grown, and herbaceous plants would likely be planted via broadcast seeding.

Revegetation and additional riparian planting will begin immediately after channel creation activities conclude in the fall, weather permitting. If storm events and higher flows prevent revegetation efforts from concluding in the fall, they will resume and conclude the next fall.

The temporary access roads will be revegetated no later than a year after revegetation efforts are completed. Revegetation success will be monitored annually for the first three years, then every other year for a period of ten years. The sites will be accessed by boat and foot. Anticipated equipment includes two articulating end dumps.

1.3.2.8 Construction Schedule

Project activities are scheduled to occur between June 1 and mid-November. In-water construction would occur when flows in Clear Creek are lowest and anadromous fish presence is minimized. All in-water work, except for stream crossing removal, will occur from July 1 to September 30, unless otherwise approved by NMFS and CDFW. Flows in Clear Creek during most of this work period are expected to be around the base flow of 150 cfs, and not exceed the upper operating limit of 275 cfs in September and October for temperature control. In-water work will be avoided during higher flow periods (flows above 400 cfs), such as during the spring Clear Creek pulse flows, which are approximately 400 to 800 cfs in May and June. These pulse flows are utilized to attract adult spring-run Chinook salmon to upstream spawning and holding habitat. Most in-water work, including channel excavation, riffle and log jam construction, and rootwad installation will be completed by September 30. Reclamation will coordinate with NMFS and California Department of Fish and Wildlife (CDFW) if project activities may require in-water work beyond this time.

1.3.3 Avoidance and Minimization Measures

The following proposed conservation measures will be implemented to avoid or minimize potential adverse effects on federally listed fish and wildlife species. Measures 1, 2, and 5-8 have specific features aimed at reducing impacts to federally listed fish species that are described in further detail:

(1) *Environmental Education Workshop* – Construction personnel, and all subcontractors, will be required to participate in, and fully comply with, an environmental education workshop. A member of the contractor's management staff will be required to participate in the training session to discuss the contractor's environmental protection plans.

The workshop will include, but not be limited to:

- Federal, state, and local environmental laws and permits, as well as the benefits of compliance and penalties for noncompliance with environmental requirements and conditions;
- Threatened, endangered, and other special-status species, and their habitats;
- Environmental protection measures, mitigation, compensation, and restoration.
- The importance of working exclusively in designated work zones and the importance of avoiding any impacts to environmentally sensitive exclusion zones;
- What to do when there is a potential violation; and
- Upon completion of the training all personnel will sign and date a form stating that they received and understand the materials presented.

(2) *Environmental Timeframes* – All activities will occur at times of the year determined to be the least detrimental to the environment and special-status species.

- NMFS and CDFW determined the in-water work window of July 1 to September 30 to minimize impacts to anadromous fishes. This in-water work period is when flows in Clear Creek are lowest, stream temperatures are high, and anadromous fish presence less likely.

- In-water work will not occur outside of this window, unless approved by NMFS and CDFW.

- Reclamation coordinated with NMFS and CDFW to install the stream crossing in the backwater channel for initial equipment access for vegetation removal as early as June 1, and to allow removal of the stream crossings by October 15.

- Construction activities will be occur from 7 a.m. to 7 p.m., Monday through Friday, with the option of 6 days a week when needed.

(3) *Fish Conservation Measures* – The contractor will design all stream crossings to ensure that conditions are maintained for effective upstream and downstream fish passage, at all times and under all flow conditions. This would include the following conservation measures:

- Prior to unavoidable in-water activities, equipment or materials will be operated/placed slowly and deliberately to alert and cause any adult and juvenile salmonids to move away from the activity area. This will be repeated after extended periods of inactivity that give fishes time to reoccupy the site.

- In-water activities, such as construction of the proposed channel alignment, new alcoves, and the log jam will be isolated from Clear Creek by constructing diversion berms. The berms will either be covered with a geomembrane, or turbidity curtains will be installed to contain any turbid water.

- Fish rescue and relocation operations will occur prior to construction of crossings, diversion berms, installation of turbidity curtains, or pumping.

- Water pumps used to remove water from isolated work areas prior to construction in the existing backwater channel and pond will be screened with mesh, according to NMFS's 1997 *Fish Screening Criteria for Anadromous Salmonids*. The screen slots would be 1/4–inch and the intake pump would be equipped with a velocity-reducing device to further prevent debris and aquatic organisms from entering the pump system.

- Fish capture and relocation operations will be implemented by qualified fish biologists and conducted in the manner described in the *Fish Relocation* section of the *Project Description* (Section 1.3.2) following NMFS electrofishing guidelines (NMFS 2000).

- The contractor will design all stream crossings to ensure that conditions are maintained for effective upstream and downstream fish passage, at all times and under all appropriate flow conditions.

(4) *Water Quality – Turbidity/Sedimentation Control* - Measures to avoid and minimize the potential for adverse effects of turbidity or resuspension of sediment during instream work on the listed anadromous species shall include the following:

- The contractor will develop and implement a Storm Water Pollution Prevention Plan (SWPPP) in coordination with the CV Water Board and other regulatory agencies. The SWPPP will include measures to minimize erosion and sediment from storm water runoff to Clear Creek, including sediment containment devices, protection of construction spoils, and proper installation of diversion berms. Methods may include, but are not limited to, straw bales, straw wattles, and silt fences around ground disturbance and stockpiles.

- During in-water work, turbidity will be monitored to remain within criteria established by the CV Water Board in the Clean Water Act, Section 401 Water Quality Certification obtained for the project. Requirements may include, but not be limited to, monitoring turbidity levels immediately upstream and approximately 300 feet downstream of in-water work every four hours to ensure they do not exceed turbidity criteria.

- A standing water removal plan will be prepared and implemented by the contractor, as approved by the CV Water Board. Removed water would either be pumped to water trucks to be used for dust abatement throughout the Project site, or discharged to a settling basin excavated on-site to allow infiltration or evaporation. The settling basin would be located east of the existing pond, at least 50 feet away from the main Clear Creek channel, and pumping velocities would be adjusted to ensure discharge does not exceed infiltration or evaporation. A berm and silt fence would be constructed around the settling basin to ensure no runoff water discharges into waters of the U.S. The settling basin will be located within the footprint of the proposed channel alignment; therefore, settled sediments will eventually be excavated during channel creation, and the area may be covered with native material 2.5 to 5 inches in depth.

- Mature riparian vegetation will be avoided to the extent feasible. All areas of ground disturbance will be revegetated with native plant species. Vegetative cover reduces the potential for erosion and storm water sediment runoff.

- Construction of the new channel alignment will be isolated from the existing channel by first constructing diversion berms and turbidity curtains before working in-water and potentially causing turbidity in the creek.

- Diversion berms will either be lined with a plastic material or turbidity curtains will be used, as necessary, around in-water work areas to minimize turbidity such as for constructing the alcoves, temporary stream crossings, and the logjam.

- Temporary stream crossings will be constructed to have minimal effect on water quality and flows; they could consist of either a railroad flat car bridge or clean spawning gravel and cobble with culverts, or something similar. Following completion of restoration activities, any spawning gravel used for crossings would either be removed from the stream channel or spread evenly across the bottom of the channel.

- Removal of diversion berms and allowing of creek flows to occupy the new channel will occur gradually to minimize turbidity downstream.

- Disturbed areas not revegetated immediately after construction completion and that will be monitored under an adaptive management plan for revegetation will be stabilized with erosion control mats or similar devices until the next revegetation period. The next anticipated revegetation period is two springs after construction completion.

(5) Hazardous Waste Spill Control

- The contractor will develop and implement a Spill Prevention, Control and Countermeasures Plan (SPCCP) with the CV Water Board prior to the onset of construction to regulate the use of hazardous materials, such as petroleum-based products for equipment fuel and lubricants. The SPCCP will include measures to be implemented onsite that will keep construction and hazardous materials out of waterways and drainages. The SPCCP will include provisions for daily checks for leaks; hand-removal of external oil, grease, and mud; and the use of spill containment booms for refueling.

- Soils contaminated with fuels or chemicals will be disposed of in a suitable location to prevent discharge to surface waters.

- Temporary diversion berms will be used to isolate construction areas from flowing waters where feasible.

- All construction equipment refueling and maintenance will be restricted to designated staging areas located away from streams and sensitive habitats.

- On-site fuels and toxic materials will be placed or contained in an area protected from direct runoff.

- Spill kits will be maintained at fueling areas and other appropriate locations.

(6) *Vegetation Restoration*

- Revegetation work in all disturbance areas will begin in July and continue through the fall, during and following civil construction. Revegetation will conclude by mid-November, weather permitting. Access to the site for revegetation efforts following October 15 will occur by foot or boat.

- Impacts to existing vegetation, especially mature riparian communities, will be avoided to the extent feasible.

- Disturbed areas will be revegetated with native plant species.

- A riparian and wetland habitat restoration plan was prepared for the LCC FSCRP, which describes the conceptual methods for restoring riparian and wetland habitats. The plan also includes success criteria along with remedial measures in the event that the established success criteria are not met. The plan was reviewed and approved by the USACE in 2007 prior to the implementation of Phase 2 of the LCC FSCRP and will be used for this Project's revegetation success.

- A botanist with Reclamation's Technical Service Center is preparing a specific riparian habitat/revegetation design for the Project, in coordination with BLM, which will increase the area of riparian habitat and native vegetative cover in this reach of Clear Creek.

- Prior to arriving at the construction area, all equipment used for the project will be thoroughly washed off-site to remove invasive plant seed, stems, etc. and inspected to prevent transfer.

- The project will be monitored, and maintenance performed, over the next ten years, with adjustments made as necessary per a separate *Revegetation and Monitoring Plan* prepared by BLM and Reclamation, developed post-civil construction activities. New temporary access roads that are still necessary to monitor and adjust the revegetated areas will be seeded or covered with jute matting to protect against erosion between monitoring years, then restored and revegetated by the end of the 10-year monitoring and maintenance period. If the monitoring results indicate a need for site modification with heavy equipment, the stream crossing may need to be reactivated. The location of the crossing may shift slightly due to channel adjustments and site evolution.

2. ENDANGERED SPECIES ACT:

BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provides an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes non-discretionary reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

2.1 Analytical Approach

This opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "to jeopardize the continued existence of a listed species," which is "to engage in an action that would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR § 402.02). Therefore, the jeopardy analysis considers both survival and recovery of the species.

This opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214).

The designations of critical habitat for species use the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

We use the following approach to determine whether a proposed action is likely to jeopardize listed species, or destroy or adversely modify critical habitat:

- Identify the range wide status of the species and critical habitat likely to be adversely affected by the proposed action.

- Describe the environmental baseline in the action area.

- Analyze the effects of the proposed action on both species and their habitat using an “exposure-response-risk” approach.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors by: (1) Reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.
- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.
- If necessary, define a reasonable and prudent alternative to the proposed action.

2.2 Range wide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions (Table 1). This informs the description of the species’ likelihood of both survival and recovery. The species status section also helps to inform the description of the species’ current “reproduction, numbers, or distribution” as described in 50 CFR § 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that value for the conservation of the listed species.

Table 1. *ESA listing history.*

Species Name	**ESU or DPS**	**Current Final Listing Status**	**Critical Habitat Designated**
Chinook salmon (*Oncorhynchus tshawytscha)*	Central Valley spring-run ESU	6/28/2005 70 FR 37160 Threatened	9/2/2005 70 FR 52488
Steelhead (*O. mykiss*)	California Central Valley DPS	1/5/2006 71 FR 834 Threatened	9/2/2005 70 FR 52488

The most recent status reviews conducted by NMFS for CV spring-run Chinook salmon (NMFS 2016a) and CCV steelhead (NMFS 2016b) concluded that the species’ status should remain as previously listed in 2005/2006 (81 FR 33468; 26 May 2016). The previous status reviews completed in 2011, also concluded that the species’ status should remain as previously listed (NMFS 2011a, 2011b).

2.2.1 Central Valley Spring-run Chinook Salmon

Central Valley (CV) spring-run Chinook salmon were listed as threatened on September 16, 1999 (64 FR 50394). This ESU consists of spring-run Chinook salmon occurring in the Sacramento River basin. The Feather River Fish Hatchery (FRFH) spring-run Chinook salmon population has been included as part of the CV spring-run Chinook salmon ESU in the most recent modification of the CV spring-run Chinook salmon listing status on June 28, 2005 (70 FR 37160). Critical habitat was designated for CV spring-run Chinook salmon on September 2, 2005 (70 FR 52488), and includes the action area for the proposed project. It includes stream reaches of the Feather and Yuba rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the main stem of the Sacramento River from Keswick Dam through the Delta; and portions of the network of channels in the northern Delta.

Historically spring-run Chinook salmon were the second most abundant salmon run in the CV and one of the largest on the west coast (CDFG 1990, 1998). These fish occupied the upper and middle reaches (1,000 to 6,000 feet) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults (Stone 1874, Rutter 1904, Clark 1929). The CV Technical Review Team estimated that historically there were 18 or 19 independent populations of CV spring-run Chinook salmon, along with a number of dependent populations, all within four distinct geographic regions (diversity groups) (Lindley *et al.* 2004). Of these 18 populations, only three extant populations currently exist (Mill, Deer, and Butte creeks on the upper Sacramento River) and they represent only the northern Sierra Nevada diversity group. All populations in the basalt and porous lava diversity group and the southern Sierra Nevada diversity group have been extirpated. The northwestern California diversity group did not historically contain independent populations, and currently contains two or three populations that are likely dependent on the northern Sierra Nevada diversity group populations for their continued existence.

Construction of low elevation dams in the foothills of the Sierras on the Mokelumne, Stanislaus, Tuolumne, and Merced rivers, has thought to have extirpated CV spring-run Chinook salmon from these watersheds of the San Joaquin River, as well as on the American and Yuba rivers of the Sacramento River basin. However, observations in the last decade suggest that perhaps a naturally occurring population may persist in the Stanislaus and Tuolumne as well as the Yuba River (Franks 2015). Naturally-spawning populations of CV spring-run Chinook salmon are currently restricted to accessible reaches of the upper Sacramento River, Antelope Creek, Battle Creek, Beegum Creek, Big Chico Creek, Butte Creek, Clear Creek, Deer Creek, Feather River, Mill Creek, and the Yuba River (CDFG 1998).

The construction of Shasta and Keswick dams on the Sacramento River and Oroville Dam on the Feather River and subsequent blocking of upstream migration has eliminated the spatial separation between spawning fall-run and spring-run Chinook salmon (Lindley *et al.* 2007). Reportedly, spring-run Chinook salmon migrated to the upper Feather River and its tributaries from mid-March through the end of July (CDFG 1998). Fall-run Chinook salmon reportedly migrated later and spawned in lower reaches of the Feather River than spring-run Chinook salmon (Yoshiyama *et al.* 2001). The same pattern also likely exists on the Sacramento River. Restricted access to historic spawning grounds currently causes spring-run Chinook salmon to spawn in the same lowland reaches that fall-run Chinook salmon use as spawning habitat. The overlap in spawning site locations, combined with an overlap in spawning timing (Moyle 2002) with temporally adjacent runs, is responsible for interbreeding between spring-run and fall-run Chinook salmon in the lower Feather River (Hedgecock *et al.* 2001) and in the Sacramento River below Keswick Dam. In the upper Sacramento River, lower Feather River, and lower Yuba River, spring-run Chinook salmon spawning may occur a few weeks earlier than fall-run spawning, but currently there is no clear distinction between the two because of the disruption of spatial segregation by Shasta and Keswick dams on the Sacramento River, Oroville Dam on the Feather River, and Englebright Dam on the Yuba River. Thus, spring-run and fall-run Chinook salmon spawning overlap temporally and spatially.

This presents difficulties from a management perspective in determining the proportional contribution of total spawning escapement by the spring- and fall-runs. Because of unnaturally high densities of spawning, particularly in the in the low flow channel of the Feather River, spawning habitat is likely a limiting factor. Intuitively, it could be inferred that the slightly earlier spawning Chinook salmon displaying spring-run behavior would have better access to the limited spawning habitat, although early spawning likely leads to a higher rate of redd superimposition. Redd superimposition occurs when spawning Chinook salmon dig redds on top of existing redds dug by other Chinook salmon. The rate of superimposition is a function of spawning densities and typically occurs in systems where spawning habitat is limited (Fukushima *et al.* 1998). Redd superimposition may disproportionately affect early spawners and, therefore, potentially affect Chinook salmon exhibiting spring-run life history characteristics salmon (Lindley *et al.* 2007).

The distribution and timing of CV spring-run Chinook salmon varies depending on the life stage, and is shown below (Table 2).

Table 2. The temporal occurrence of adult (a), adult holding (b), adult spawning (c), and juvenile (d) Central Valley spring-run Chinook salmon in the Sacramento River. Darker shades indicate months of greatest relative abundance.

(a) Adult migration

Time Period and Location	Early Jan	Late Jan	Early Feb	Late Feb	Early Mar	Late Mar	Early Apr	Late Apr	Early May	Late May	Early Jun	Late Jun	Early Jul	Late Jul	Early Aug	Late Aug	Early Sep	Late Sep	Early Oct	Late Oct	Early Nov	Late Nov	Early Dec	Late Dec
Sac. River basin[a,b]	N	N	N	N	M	M	M	M	H	H	H	H	M	M	M	M	M	M	L	N	N	N	N	N
Sac. River Mainstem[b,c]	N	L	L	L	M	M	M	M	M	M	M	M	M	M	L	L	N	N	N	N	N	N	N	N
Mill Creek[d]	N	N	N	N	L	L	M	H	H	H	H	M	M	L	L	N	N	N	N	N	N	N	N	N
Deer Creek[d]	N	N	N	N	L	L	M	H	H	H	H	M	M	N	N	N	N	N	N	N	N	N	N	N
Butte Creek[d,g]	N	N	L	M	M	M	M	H	H	H	H	M	L	N	N	N	N	N	N	N	N	N	N	N
(b) Adult Holding[a,b]	N	N	N	L	L	M	M	H	H	H	H	H	H	H	H	M	M	L	L	N	N	N	N	N
(c) Adult Spawning[a,b,c]	N	N	N	N	N	N	N	N	N	N	N	N	N	N	L	M	H	H	M	L	N	N	N	N

(d) Juvenile migration

Time Period and Location	Early Jan	Late Jan	Early Feb	Late Feb	Early Mar	Late Mar	Early Apr	Late Apr	Early May	Late May	Early Jun	Late Jun	Early Jul	Late Jul	Early Aug	Late Aug	Early Sep	Late Sep	Early Oct	Late Oct	Early Nov	Late Nov	Early Dec	Late Dec
Sac. River Tribs[e]	M	M	M	M	M	M	N	N	N	N	N	N	N	N	N	N	N	N	M	M	H	H	H	H
Upper Butte Creek[f,g]	H	H	H	H	M	M	M	M	M	M	L	L	N	N	N	N	N	N	L	L	L	L	H	H
Mill, Deer, Butte Creeks[d,g]	H	H	H		M	M	M	M	M	M	L	L	N	N	N	N	N	N	L	L	L	L	L	L
Sac. River at RBDD[c]	H	H	L	L	L	L	L	L	L	N	N	N	N	N	N	N	N	N	N	N	H	H	H	H
Sac. River at KL[h]	M	M	M	M	H	H	H	H	M	M	N	N	N	N	N	N	N	N	N	N	M	M	H	H

Sources: [a]Yoshiyama et al. (1998); [b]Moyle (2002); [c]Myers et al. (1998); [d]S. T. Lindley et al. (2004); [e]CDFG (1998); [f]McReynolds, Garman, Ward, and Plemons (2007); [g]P. D. Ward, McReynolds, and Garman (2003); [h]Snider and Titus (2000)

Note: Yearling spring-run Chinook salmon rear in their natal streams through the first summer following their birth. Downstream emigration generally occurs the following fall and winter. Most young-of-the-year spring-run Chinook salmon emigrate during the first spring after they hatch.

Relative Abundance: H = High M = Medium L = Low N = Not Present

2.2.1.1 Critical Habitat: Physical and Biological Features (PBFs)

Critical habitat for CV spring-run Chinook salmon includes stream reaches of the Feather, Yuba and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches (70 FR 52488; September 2, 2005) and the lateral extent as defined by the OHWM. In areas where the OHWM 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 one to two years on the annual flood series) (Bain & Stevenson 1999; 70 FR 52488). Critical habitat for CV spring-run Chinook salmon is defined as specific areas that contain the PBFs essential to the conservation of the species. Following are the inland habitat types used as PBFs for CV spring-run Chinook salmon.

2.2.1.1.1 Spawning Habitat

Freshwater spawning sites are those with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development. Most spawning habitat in the CV for Chinook salmon is located in areas directly downstream of dams containing suitable environmental conditions for spawning and incubation. Spawning habitat for CV spring-run Chinook salmon occurs on the mainstem Sacramento River between Red Bluff Diversion Dam (RBDD) and Keswick Dam and in tributaries such as Mill, Deer, and Butte creeks; as well as the Feather and Yuba rivers, and Big Chico, Battle, Antelope, and Clear creeks. However, little spawning activity has been recorded in recent years on the Sacramento River mainstem for spring-run Chinook salmon. Even in degraded reaches, spawning habitat has a high value as its function directly affects the spawning success and reproductive potential of listed salmonids.

2.2.1.1.2 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 mobility; water quality and forage supporting juvenile salmonid development; and natural cover such as shade, submerged and overhanging large woody material, log jams and beaver dams, 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 piscivorous fishes and birds. Freshwater rearing habitat also has a high intrinsic 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.

2.2.1.1.3 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 passage of adults and the downstream emigration of juveniles. 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 adults, upstream passage through the Delta and much of the Sacramento River is not a problem, yet a number of challenges exist on many tributary streams. For juveniles, unscreened or inadequately screened water diversions throughout their migration corridors and a scarcity of complex in-river cover have degraded this PBF. However, since the primary migration corridors are used by numerous populations and are essential for connecting early rearing habitat with the ocean, even the degraded reaches are considered to have a high intrinsic value for the conservation of the species.

2.2.1.1.4 Estuarine Areas

This PBF is outside of the action area for the proposed action. The remaining estuarine habitat for these species is severely degraded by altered hydrologic regimes, poor water quality, reductions in habitat complexity, and competition for food and space with exotic species. Regardless of the condition, the remaining estuarine areas are of high value because they provide factors which function to provide predator avoidance, as rearing habitat and as an area of transition to the ocean environment.

2.2.1.2 Description of Viable Salmonid Population (VSP) Parameters

2.2.1.2.1 Abundance

The Central Valley drainage as a whole is estimated to have supported spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (CDFG 1998). The San Joaquin River historically supported a large run of spring-run Chinook salmon, suggested to be one of the largest runs of any Chinook salmon on the West Coast with estimates averaging 200,000 – 500,000 adults returning annually (CDFG 1990). Construction of Friant Dam on the San Joaquin River began in 1939, and when completed in 1942, blocked access to all upstream habitat.

The FRFH spring-run Chinook salmon population represents a remaining evolutionary legacy of the spring-run Chinook salmon populations that once spawned above Oroville Dam, and has been included in the ESU based on its genetic linkage to the natural spawning population, and the potential development of a conservation strategy, for the hatchery program. Abundance from 1993 to 2004 were consistently over 4,000 (averaging nearly 5,000), while 2005 to 2014 were lower, averaging just over 2,000 (CDFW 2015).

Monitoring of the Sacramento River mainstem during spring-run Chinook salmon spawning timing indicates some spawning occurs in the river. Here, the lack of physical separation of spring-run Chinook salmon from fall-run Chinook salmon is complicated by overlapping migration and spawning periods. Significant hybridization with fall-run Chinook salmon makes identification of spring-run Chinook salmon in the mainstem difficult to determine, but counts of Chinook salmon redds in September are typically used as an indicator of spring-run Chinook salmon abundance. Redd surveys conducted in September between 2001 and 2011 have observed an average of 36 Chinook salmon redds from Keswick Dam downstream to the RBDD, ranging from 3 to 105 redds; in 2012 zero redds were observed, and in 2013, 57 redds were observed in September 2014 (CDFW 2015). Therefore, even though physical habitat conditions can support spawning and incubation, spring-run Chinook salmon depend on spatial segregation and geographic isolation from fall-run Chinook salmon to maintain genetic diversity. With the onset of fall-run Chinook salmon spawning occurring in the same time and place as potential spring-run Chinook salmon spawning, it is likely extensive introgression between the populations has occurred (CDFG 1998). For these reasons, Sacramento River mainstem spring-run Chinook salmon are not included in the following discussion of ESU abundance trends.

For many decades, CV spring-run Chinook salmon were considered extirpated from the Southern Sierra Nevada diversity group in the San Joaquin River Basin, despite their historical numerical dominance in the Basin (Fry 1961, Fisher 1994). More recently, there have been reports of adult Chinook salmon returning in February through June to San Joaquin River tributaries, including the Mokelumne, Stanislaus, and Tuolumne rivers (Franks 2014, Workman 2003, FishBio 2015). These spring-running adults have been observed in several years and exhibit typical spring-run life history characteristics, such as returning to tributaries during the springtime, over-summering in deep pools, and spawning in early fall (Franks 2014, Workman 2003, FishBio 2015). For example, 114 adult were counted on the video weir on the Stanislaus River between February and June in 2013 with only seven individuals without adipose fins (FishBio 2015).

Additionally, in 2014, implementation of the spring-run Chinook salmon reintroduction plan into the San Joaquin River has begun, which if successful will benefit the spatial structure, and genetic diversity of the ESU. These reintroduced fish have been designated as a nonessential experimental population under ESA Section 10(j) when within the defined boundary in the San Joaquin River (78 FR 79622; December 31, 2013). Furthermore, while the San Joaquin River Restoration Project (SJRRP) is managed to imprint CV spring-run Chinook salmon to the mainstem San Joaquin River, we do anticipate that the reintroduced spring-run Chinook salmon are likely to stray into the San Joaquin tributaries at some level, which will increase the likelihood for CV spring-run Chinook salmon to repopulate other Southern Sierra Nevada diversity group rivers where suitable conditions exist.

Sacramento River tributary populations in Mill, Deer, and Butte creeks are likely the best trend indicators for the CV spring-run Chinook salmon ESU as a whole because these streams contain the majority of the abundance, and are currently the only independent populations within the ESU. Generally, these streams have shown a positive escapement trend since 1991, displaying broad fluctuations in adult abundance, ranging from 1,013 in 1993 to 23,788 in 1998. Escapement numbers are dominated by Butte Creek returns, which averaged over 7,000 fish from 1995 to 2005, but then declined in years 2006 through 2011 with an average of just over 3,000 (although 2008 was nearly 15,000 fish). During this same period, adult returns on Mill and Deer creeks have averaged over 2,000 fish total and just over 1,000 fish total, respectively. From 2001 to 2005, the CV spring-run Chinook salmon ESU experienced a trend of increasing abundance in some natural populations, most dramatically in the Butte Creek population (Good *et al.* 2005).

Additionally, in 2002 and 2003, mean water temperatures in Butte Creek exceeded 21ºC for 10 or more days in July (Williams 2006). These persistent high water temperatures, coupled with high fish densities, precipitated an outbreak of Columnaris (*Flexibacter columnaris*) and Ichthyophthiriasis (*Ichthyophthirius multifiis*) diseases in the adult spring-run Chinook salmon over-summering in Butte Creek. In 2002, this contributed to a pre-spawning mortality of approximately 20 to 30 percent of the adults. In 2003, approximately 65 percent of the adults succumbed, resulting in a loss of an estimated 11,231 adult spring-run Chinook salmon in Butte Creek due to the diseases. In 2015, Butte Creek again experienced severe temperature conditions, with nearly 2,000 fish entering the creek, only 1,081 observed during the snorkel survey, and only 413 carcasses observed, which indicates a large number of pre-spawn mortality.

Declines in abundance from 2005 to 2011, placed the Mill Creek and Deer Creek populations in the high extinction risk category due to the rates of decline, and in the case of Deer Creek, also the level of escapement (NMFS 2011a). Butte Creek has sufficient abundance to retain its low extinction risk classification, but the rate of population decline in years 2006 through 2011 was nearly sufficient to classify it as a high extinction risk based on this criteria. Nonetheless, the watersheds identified as having the highest likelihood of success for achieving viability/low risk of extinction include Butte, Deer and Mill creeks (NMFS 2011a). Some other tributaries to the Sacramento River, such as Clear Creek and Battle Creek have seen population gains in the years from 2001 to 2009, but the overall abundance numbers have remained low. 2012 appeared to be a good return year for most of the tributaries with some, such as Battle Creek, having the highest return on record (799). Additionally, 2013 escapement numbers increased, in most tributary populations, which resulted in the second highest number of spring-run Chinook salmon returning to the tributaries since 1998. However, 2014 abundance was lower, with just over 5,000 fish for the tributaries combined, which indicates a highly fluctuating and unstable ESU abundance. Even more concerning was returns for 2015, which were record lows for some populations. In the next several years, numbers are anticipated to remain quite low as the effects of the 2012-2015 drought are fully realized.

2.2.1.2.2 Productivity

The productivity of a population (*i.e.*, production over the entire life cycle) can reflect conditions (*e.g.,* environmental conditions) that influence the dynamics of a population and determine abundance. In turn, the productivity of a population allows an understanding of the performance of a population across the landscape and habitats in which it exists and its response to those habitats (McElhany *et al.* 2000). In general, declining productivity equates to declining population abundance. McElhany *et al.* (2000) suggested criteria for a population's natural productivity should be sufficient to maintain its abundance above the viable level (a stable or increasing population growth rate). In the absence of numeric abundance targets, this guideline is used. Cohort replacement rates (CRR) are indications of whether a cohort is replacing itself in the next generation.

From 1993 to 2007 the 5-year moving average of the CV spring-run Chinook salmon tributary population CRR remained over 1.0, but then declined to a low of 0.47 in years 2007 through 2011 (Table 3). The productivity of the Feather River and Yuba River populations and contribution to the CV spring-run Chinook salmon ESU currently is unknown; however, the FRFH currently produces 2,000,000 juveniles each year. The CRR for the 2012 combined tributary population was 3.84, and 8.68 in 2013, due to increases in abundance for most populations. Although 2014 returns were lower than the previous two years, the CRR was still positive (1.85). However, 2015 returns were very low, with a CRR of 0.14, when using Butte Creek snorkel survey numbers, the lowest on record. Using the Butte Creek carcass surveys, the 2015 CRR for just Butte Creek was only 0.02.

Table 3. Central Valley Spring-run Chinook salmon population estimates from CDFW Grand Tab (2015) with corresponding cohort replacement rates for years since 1986.

Year	Sacramento River Basin Escapement Run Size[a]	FRFH Population	Tributary Populations	5-Year Moving Average Tributary Population Estimate	Trib CRR[b]	5-Year Moving Average of Trib CRR	5-Year Moving Average of Basin Population Estimate	Basin CRR	5-Year Moving Average of Basin CRR
1986	3,638	1,433	2,205						
1987	1,517	1,213	304						
1988	9,066	6,833	2,233						
1989	7,032	5,078	1,954		0.89			1.93	
1990	3,485	1,893	1,592	1,658	5.24		4,948	2.30	
1991	5,101	4,303	798	1,376	0.36		5,240	0.56	
1992	2,673	1,497	1,176	1,551	0.60		5,471	0.38	
1993	5,685	4,672	1,013	1,307	0.64	1.55	4,795	1.63	1.22
1994	5,325	3,641	1,684	1,253	2.11	1.79	4,454	1.04	1.18
1995	14,812	5,414	9,398	2,814	7.99	2.34	6,719	5.54	1.83
1996	8,705	6,381	2,324	3,119	2.29	2.73	7,440	1.53	2.03
1997	5,065	3,653	1,412	3,166	0.84	2.77	7,918	0.95	2.14
1998	30,533	6,746	23,787	7,721	2.53	3.15	12,888	2.06	2.23
1999	9,838	3,731	6,107	8,606	2.63	3.26	13,791	1.13	2.24
2000	9,201	3,657	5,544	7,835	3.93	2.44	12,669	1.82	1.50
2001	16,865	4,135	12,730	9,916	0.54	2.09	14,300	0.55	1.30
2002	17,212	4,189	13,023	12,238	2.13	2.35	16,730	1.75	1.46
2003	17,691	8,662	9,029	9,287	1.63	2.17	14,161	1.92	1.43
2004	13,612	4,212	9,400	9,945	0.74	1.79	14,916	0.81	1.37
2005	16,096	1,774	14,322	11,701	1.10	1.23	16,295	0.94	1.19
2006	10,828	2,061	8,767	10,908	0.97	1.31	15,088	0.61	1.21
2007	9,726	2,674	7,052	9,714	0.75	1.04	13,591	0.71	1.00
2008	6,162	1,418	4,744	8,857	0.33	0.78	11,285	0.38	0.69
2009	3,801	989	2,812	7,539	0.32	0.69	9,323	0.35	0.60
2010	3,792	1,661	2,131	5,101	0.30	0.53	6,862	0.39	0.49
2011	5,033	1,969	3,064	3,961	0.65	0.47	5,703	0.82	0.53
2012	14,724	3,738	10,986	4,747	3.91	1.10	6,702	3.87	1.16
2013	18,384	4,294	14,090	6,617	6.61	2.36	9,147	4.85	2.06
2014	8,434	2,776	5,658	7,186	1.85	2.66	10,073	1.68	2.32
2015	3,074	1,586	1,488	7,057	0.14	2.63	9,930	0.21	2.28
Median	9,775	3,616	6,159	6,541	1.97	1.89	10,220	1.00	1.46

[a] NMFS is only including the escapement numbers from the Feather River Fish Hatchery (FRFH) and the Sacramento River tributaries in this table. Sacramento River Basin run size is the sum of the escapement numbers from the FRFH and the tributaries. [b] Abbreviations: CRR = Cohort Replacement Rate, Trib = tributary

2.2.1.2.3 Spatial Structure

Spatial structure refers to the arrangement of populations across the landscape, the distribution of spawners within a population, and the processes that produce these patterns. Species with a restricted spatial distribution and few spawning areas are at a higher risk of extinction from catastrophic environmental events (*e.g.*, a single landslide) than are species with more widespread and complex spatial structure. Species or population diversity concerns the phenotypic (*i.e.*, morphology, behavior, and life-history traits) and genotypic (DNA) characteristics of populations. Phenotypic diversity allows more populations to use a wider array of environments and protects populations against short-term temporal and spatial environmental changes. Genotypic diversity, on the other hand, provides populations with the ability to survive long-term changes in the environment. To meet the objective of representation and redundancy, diversity groups need to contain multiple populations to survive in a dynamic ecosystem subject to unpredictable stochastic events, such as pyroclastic events or wild fires.

The Central Valley Technical Review Team estimated that historically there were 18 or 19 independent populations of CV spring-run Chinook salmon, along with a number of dependent populations, all within four distinct geographic regions, or diversity groups (Figure 5) (Lindley *et al.* 2004). Of these populations, only three independent populations currently exist (Mill, Deer, and Butte creeks, tributaries to the upper Sacramento River) and they represent only the northern Sierra Nevada diversity group. Additionally, smaller populations are currently persisting in Antelope and Big Chico creeks, and the Feather and Yuba rivers in the northern Sierra Nevada diversity group (CDFG 1998).

Most historical populations in the basalt and porous lava diversity group and the southern Sierra Nevada diversity group have been extirpated; Battle Creek in the basalt and porous lava diversity group has had a small persistent population in Battle Creek since 1995, and the upper Sacramento River may have a small persisting population spawning in the river mainstem as well. The northwestern California diversity group did not historically contain independent populations, and currently contains two small persisting populations, in Clear Creek, and Beegum Creek (tributary to Cottonwood Creek) that are likely dependent on the northern Sierra Nevada diversity group populations for their continued existence. Construction of low elevation dams in the foothills of the Sierras on the San Joaquin, Mokelumne, Stanislaus, Tuolumne, and Merced rivers, has thought to have extirpated CV spring-run Chinook salmon from these watersheds of the San Joaquin River, as well as on the American River of the Sacramento River basin. However, observations in the last decade suggest that perhaps spring-running populations may currently occur in the Stanislaus and Tuolumne rivers (Franks 2014).

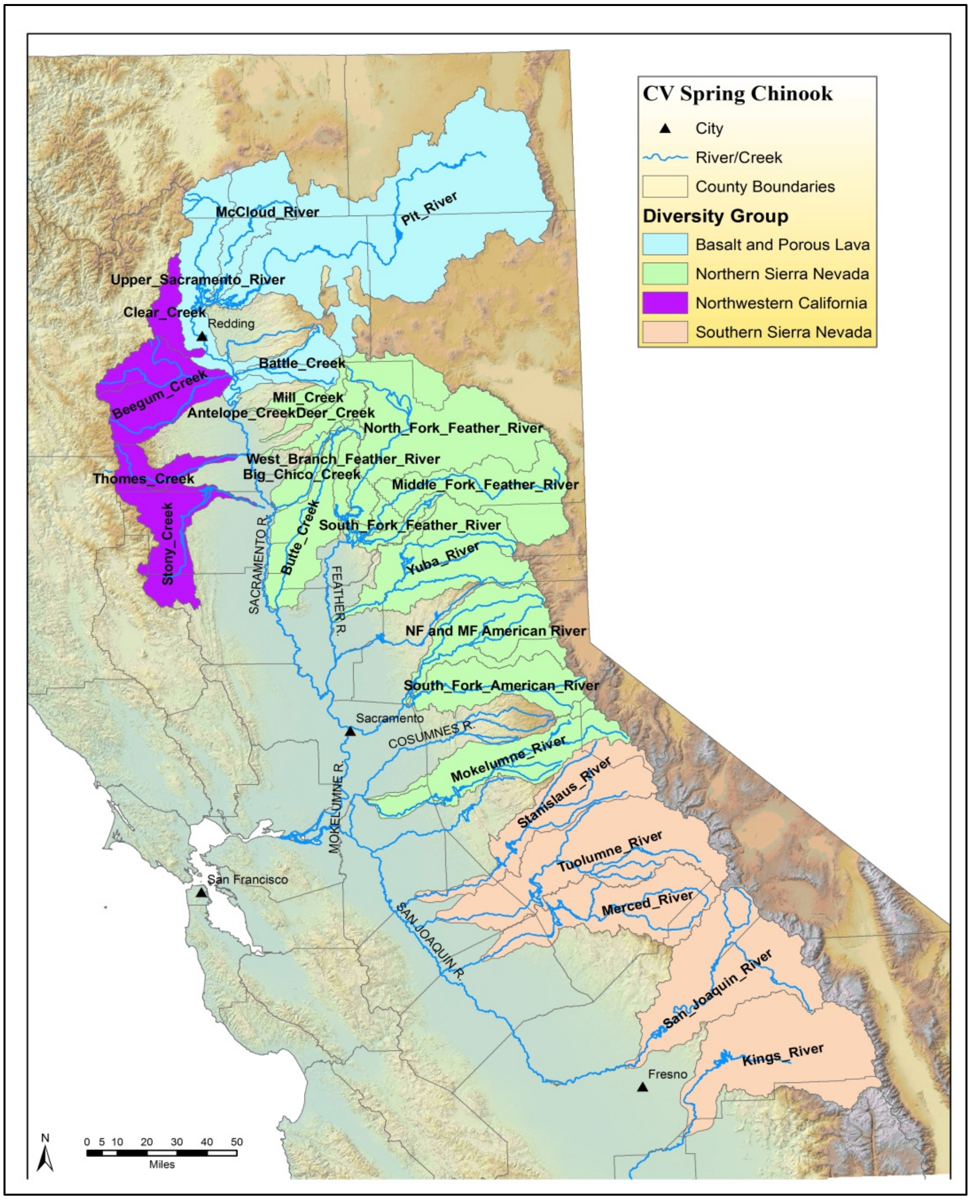

Figure 5. Diversity Groups for the Central Valley spring-run Chinook salmon ESU.

With only one of four diversity groups currently containing independent populations, the spatial structure of CV spring-run Chinook salmon is severely reduced. Butte Creek spring-run Chinook salmon adult returns are currently utilizing all available habitat in the creek; and it is unknown if individuals have opportunistically migrated to other systems. The persistent populations in Clear Creek and Battle Creek, with habitat restoration projects completed and more underway, are anticipated to add to the spatial structure of the CV spring-run Chinook salmon ESU if they can reach viable status in the basalt and porous lava and northwestern California diversity group areas. The spatial structure of the spring-run Chinook salmon ESU would still be lacking due to the extirpation of all San Joaquin River basin spring-run Chinook salmon populations; however, recent information suggests that perhaps a self-sustaining population of spring-run Chinook salmon is occurring in some of the San Joaquin River tributaries, most notably the Stanislaus and the Tuolumne rivers.

A final rule was published to designate a nonessential experimental population of CV spring-run Chinook salmon to allow reintroduction of the species below Friant Dam on the San Joaquin River as part of the SJRRP (78 FR 79622; December 31, 2013). Pursuant to ESA Section 10(j), with limited exceptions, each member of an experimental population shall be treated as a threatened species. The rule includes protective regulations under ESA section 4(d) that provide specific exceptions to prohibitions for taking CV spring-run Chinook salmon within the experimental population area, and in specific instances elsewhere. The first release of CV spring-run Chinook salmon juveniles into the San Joaquin River occurred in April 2014. Releases have continued annually during the spring. The SJRRP's future long-term contribution to the CV spring-run Chinook salmon ESU has yet to be determined.

Snorkel surveys (Kennedy & Cannon 2005) conducted between October 2002 to October 2004 on the Stanislaus River identified adults in June 2003 and 2004, as well as observed Chinook fry in December 2003, which would indicate spring-run Chinook salmon spawning timing. In addition, monitoring on the Stanislaus since 2003 and on the Tuolumne since 2009 has indicated upstream migration of adult spring-run Chinook salmon (Anderson *et al.* 2007), and 114 adult were counted on the video weir on the Stanislaus River between February and June in 2013 with only 7 individuals without adipose fins (FishBio 2015). Finally, rotary screw trap data provided by Stockton U.S. Fish and Wildlife Service (USFWS) corroborates the spring-run Chinook salmon adult timing, by indicating that there are a small number of fry migrating out of the Stanislaus and Tuolumne at a period that would coincide with spring-run juvenile emigration (Franks 2014). Although there have been observations of springtime running Chinook salmon returning to the San Joaquin tributaries in recent years, there is insufficient information to determine the specific origin of these fish, and whether or not they are straying into the basin or returning to natal streams. Genetic assessment or natal stream analyses of hard tissues could inform our understanding of the relationship of these fish to the ESU.

Lindley *et al.* (2007) described a general criteria for "representation and redundancy" of spatial structure, which was for each diversity group to have at least two viable populations. More specific recovery criteria for the spatial structure of each diversity group have been laid out in the NMFS Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014). According to the criteria, one viable population in the Northwestern California diversity group, two viable populations in the basalt and porous lava diversity group, four viable populations in the northern Sierra Nevada diversity group, and two viable populations in the southern Sierra Nevada diversity group, in addition to maintaining dependent populations, are needed for recovery. It is clear that further efforts will need to involve more than restoration of currently accessible watersheds to make the ESU viable. The NMFS Central Valley Salmon and Steelhead Recovery Plan calls for reestablishing populations into historical habitats currently blocked by large dams, such as the reintroduction of a population upstream of Shasta Dam, and to facilitate passage of fish upstream of Englebright Dam on the Yuba River (NMFS 2014).

2.2.1.2.4 Diversity

Diversity, both genetic and behavioral, is critical to success in a changing environment. Salmonids express variation in a suite of traits, such as anadromy, morphology, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, and physiology and molecular genetic characteristics (including rate of gene-flow among populations). Criteria for the diversity parameter are that human-caused factors should not alter variation of traits. The more diverse these traits (or the more these traits are not restricted), the more adaptable a population is, and the more likely that individuals, and therefore the species, would survive and reproduce in the face of environmental variation (McElhany *et al.* 2000). However, when this diversity is reduced due to loss of entire life history strategies or to loss of habitat used by fish exhibiting variation in life history traits, the species is in all probability less able to survive and reproduce given environmental variation.

The CV spring-run Chinook salmon ESU is comprised of two known genetic complexes. Analysis of natural and hatchery CV spring-run Chinook salmon stocks in the Central Valley indicates that the northern Sierra Nevada diversity group spring-run Chinook salmon populations in Mill, Deer, and Butte creeks retain genetic integrity as opposed to the genetic integrity of the Feather River population, which has been somewhat compromised. The Feather River spring-run Chinook salmon have introgressed with the Feather River fall-run Chinook salmon, and it appears that the Yuba River spring-run Chinook salmon population may have been impacted by FRFH fish straying into the Yuba River (and likely introgression with wild Yuba River fall-run has occurred). Additionally, the diversity of the spring-run Chinook salmon ESU has been further reduced with the loss of the majority if not all of the San Joaquin River basin spring-run Chinook salmon populations. Efforts like the SJRRP, to reintroduce a spring-run population below Friant Dam, which are underway, are needed to improve the diversity of CV spring-run Chinook salmon.

2.2.1.2.5 Summary of ESU Viability

As the populations in Butte, Deer and Mill creeks are the best trend indicators for ESU viability, we can evaluate risk of extinction based on VSP parameters in these watersheds. Lindley *et al.* (2007) indicated that the spring-run Chinook salmon populations in the Central Valley had a low risk of extinction in Butte and Deer creeks, according to their population viability analysis (PVA) model and other population viability criteria (*i.e.*, population size, population decline, catastrophic events, and hatchery influence, which correlate with VSP parameters abundance, productivity, spatial structure, and diversity). The Mill Creek population of spring-run Chinook salmon was at moderate extinction risk according to the PVA model, but appeared to satisfy the other viability criteria for low-risk status. However, the CV spring-run Chinook salmon ESU failed to meet the “representation and redundancy rule” since there are only demonstrably viable populations in one diversity group (northern Sierra Nevada) out of the three diversity groups that historically contained them, or out of the four diversity groups as described in the NMFS Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014). Over the long term, these three remaining populations are considered to be vulnerable to catastrophic events, such as volcanic eruptions from Mount Lassen or large forest fires due to the close proximity of their headwaters to each other.

In 2012 and 2013, most tributary populations increased in returning adults, averaging over 13,000. However, 2014 returns were lower again, just over 5,000 fish, indicating the ESU remains highly fluctuating. The most recent status review conducted in 2015 (NMFS 2016a) looked at promising increasing populations in 2012-2014; however, the 2015 returning fish were extremely low (1,488), with additional pre-spawn mortality reaching record highs.

The recent drought impacts on Butte Creek can be seen from the lethal water temperatures in traditional and non-traditional spring-run Chinook salmon holding habitat during the summer. Pre-spawn mortality was observed during the 2007 to 2009 drought with an estimate of 1,054 adults dying before spawning (Garman 2015, *pers*. *comm*.). A large number of adults (903 and 232) also were estimated to have died prior to spawning in the 2013 and 2014 drought, respectively (Garman 2015, *pers*. *comm*.). In 2015, late arriving adults in the Chico vicinity experienced exceptionally warm June air temperatures coupled with the PG&E flume shutdown resulting in a fish die off. Additionally, adult spring-run Chinook salmon in Mill, Deer, and Battle creeks were exposed to warm temperatures, and pre-spawn mortality was observed. Thus, while the independent CV spring-run Chinook populations have generally improved since 2010, and are considered at moderate (Mill and Deer) or low (Butte Creek) risk of extinction, these populations are likely to deteriorate over the next three years due to drought impacts, which may in fact result in severe declines.

In summary, the status of the CV spring-run Chinook salmon ESU, until 2015, has probably improved since the 2010 status review. The largest improvements are due to extensive restoration, and increases in spatial structure with historically extirpated populations trending in the positive direction. Improvements, evident in the moderate and low risk of extinction of the three independent populations, however, are certainly not enough to warrant the delisting of the ESU. The recent declines of many of the dependent populations, high pre-spawn and egg mortality during the 2012 to 2015 drought, uncertain juvenile survival during the drought, and ocean conditions, as well as the level of straying of FRFH spring-run Chinook salmon to other CV spring-run Chinook salmon populations are all causes for concern for the long-term viability of the CV spring-run Chinook salmon ESU.

2.2.2 California Central Valley Steelhead

California Central Valley (CCV) steelhead were listed as threatened on March 19, 1998, (63 FR 13347). In classifying the threatened listing of CCV steelhead DPS, NMFS highlighted the historical loss and degradation of spawning and rearing habitat as one of the major factors leading to the current low population abundances. This habitat loss and degradation is due to a combination of water development projects and operations that include, but are not limited to: (1) impassable dams, water diversions, and hydroelectric operations on almost every major river in the Central Valley; (2) antiquated fish screens, fish ladders, and diversion dams on streams throughout the Sacramento River Basin; and (3) levee construction and maintenance projects that do not incorporate fish-friendly designs. All of those projects and operations reduce the habitat quality and/or quantity for steelhead. The massive alterations to river channels from the gold mining era continue to impact aquatic habitats throughout much of the Central Valley. Busby *et al.* (1996) cited other land use practices that have degraded steelhead habitat in the Central Valley including forestry, agriculture, and urbanization of watersheds.

Good *et al.* (2005) described the threats to Central Valley salmon and steelhead as falling into three broad categories: loss of historical spawning habitat, degradation of remaining habitat, and genetic threats from the stocking programs. Cummins *et al.* (2008) attributed the much reduced biological status of Central Valley anadromous salmonid stocks to the construction and operation of the Central Valley Project (CVP) and the State Water Project (SWP):

> *"Construction and operation of the CVP and SWP have altered flows, reduced water quality, and degraded environmental conditions and reduced habitat for fish and wildlife in the Central Valley from the headwaters to the Delta. This includes the native anadromous fish of the Central Valley -- winter, spring, fall and late-fall chinook, steelhead and sturgeon. Adult runs that once numbered in the millions have been reduced to thousands or less.*
>
> *The transformation of the natural Sacramento/San Joaquin river systems into a massive water storage and delivery system includes dams and diversions that have blocked access for anadromous salmonids to much of their historical habitat. Development of the CVP and SWP has significantly modified the natural hydrologic, geomorphic, physical and biological systems. The modified river system significantly impacts the native salmon and steelhead production as a result of fragmented habitats, migration barriers, and seasonally altered flow and habitat regimes."*

However, in the last 5-10 years, some habitat restoration programs and conservation plans have been implemented that, in aggregate, should provide a benefit to the habitat of Central Valley steelhead, or are expected to do so in the future.

The Central Valley experienced a severe drought during 2012 through 2015, which likely reduced the already limited habitat quality and range for CCV steelhead during this period. The very low numbers of adults seen at the Nimbus Fish Hatchery during the last few years may be related to the drought, as water temperatures in the lower American River at Hazel Avenue reached the low 70's (°F), well above the 65°F limit set in the NMFS 2009 opinion on the long-term operations of the CVP and SWP, likely impacting survival of wild steelhead parr. Steelhead populations in the Central Valley historically dealt with periodic drought. The concern is that at current low levels of abundance and productivity, some populations may go extinct during long dry spells, and the re-establishment of these populations may be difficult due to the degraded habitat conditions.

There are indications that natural production of steelhead continues to decline and is now at very low levels. Their continued low numbers in most hatcheries, domination by hatchery fish, and relatively sparse monitoring makes the continued existence of naturally reproduced steelhead a concern. The most recent 5-year status review completed by NMFS recommends that CCV steelhead remain listed as threatened, as the DPS is likely to become endangered within the foreseeable future throughout all or a significant portion of its range (NMFS 2016b). The distribution and timing of steelhead varies depending on the life stage, and is shown in Table 4 below.

Table 4. The temporal occurrence of (a) adult and (b) juvenile California Central Valley steelhead at locations in the Central Valley. Darker shades indicate months of greatest relative abundance.

(a) Adult migration

Time Period and Location	Early Jan	Late Jan	Early Feb	Late Feb	Early Mar	Late Mar	Early Apr	Late Apr	Early May	Late May	Early Jun	Late Jun	Early Jul	Late Jul	Early Aug	Late Aug	Early Sep	Late Sep	Early Oct	Late Oct	Early Nov	Late Nov	Early Dec	Late Dec
[1]Sacramento R. at Fremont Weir	L	L	L	L	L	N	N	N	N	N	N	L	L	L	L	M	H	H	H	M	L	L	L	L
[2]Sacramento R. at RBDD	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	L	M	M	H	M	L	L	L	L
[3]Mill & Deer Creeks	M	M	H	M	M	L	L	L	L	L	L	L	N	N	N	N	N	N	M	H	H	L	L	L
[4]Mill Creek at Clough Dam	L	L	M	H	M	M	L	L	N	N	N	N	N	N	N	N	N	L	M	H	H	H	M	M
[5]San Joaquin River	H	H	M	M	L	L	N	N	N	N	N	N	L	L	L	L	M	M	M	M	M	M	H	H

(b) Juvenile migration

Time Period and Location	Early Jan	Late Jan	Early Feb	Late Feb	Early Mar	Late Mar	Early Apr	Late Apr	Early May	Late May	Early Jun	Late Jun	Early Jul	Late Jul	Early Aug	Late Aug	Early Sep	Late Sep	Early Oct	Late Oct	Early Nov	Late Nov	Early Dec	Late Dec
[1,2]Sacramento R. near Fremont Weir	L	L	L	L	M	M	M	M	M	M	M	M	L	L	L	L	L	L	M	M	M	M	L	L
[6]Sacramento R. at Knights Landing	H	H	H	H	M	M	M	M	L	L	L	L	N	N	N	N	N	N	N	N	L	L	L	L
[7]Mill & Deer Creeks (silvery parr/smolts)	L	L	L	L	M	H	H	H	H	H	L	L	N	N	N	N	N	N	L	L	L	L	L	L
[7]Mill & Deer Creeks (fry/parr)	L	L	L	L	L	L	M	M	H	H	H	H	N	N	N	N	N	N	M	M	M	M	M	M
[8]Chipps Island (clipped)	M	M	H	H	M	M	L	L	L	L	N	N	N	N	N	N	N	N	N	N	N	N	L	L
[8]ChippsIsland (unclipped)	M	M	M	M	H	H	H	H	H	H	M	M	L	L	N	N	N	N	N	N	N	N	L	L
[9]San Joaquin R. at Mossdale	N	N	L	L	M	M	H	H	H	H	L	L	N	N	N	N	N	N	L	L	N	N	N	N
[10]Mokelumne R. (silvery parr/smolts)	L	L	M	M	M	M	H	H	H	H	M	M	M	M	N	N	N	N	N	N	N	N	N	N
[10]Mokelumne R. (fry/parr)	N	N	L	L	L	L	L	L	M	M	H	H	M	M	N	N	N	N	N	N	N	N	N	N
[11]Stanislaus R. at Caswell	L	L	M	M	H	H	M	M	M	M	L	L	N	N	N	N	N	N	N	N	N	N	N	N
[12]Sacramento R. at Hood	L	L	H	H	H	H	H	H	H	H	H	N	N	N	N	N	N	N	N	N	L	L	L	L

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 & 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).

Relative Abundance: H = High M = Medium L = Low N = Not Present

2.2.2.1 Critical Habitat: Physical and Biological Features for CCV Steelhead

Critical habitat for CCV steelhead includes stream reaches such as those of the Sacramento, Feather, and Yuba rivers, and Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the San Joaquin River (up to the confluence with the Merced River), including its tributaries, and the waterways of the Delta. Following is a description of the condition of the inland habitat types used as PBFs for CCV steelhead critical habitat.

2.2.2.1.1 Spawning Habitat

Tributaries to the Sacramento and San Joaquin rivers with year-round flows have the primary spawning habitat for CCV steelhead. Most of the available spawning habitat 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. Even in degraded reaches, spawning habitat has high value, as its function directly affects the spawning success and reproductive potential for the conservation of listed salmonids.

2.2.2.1.2 Freshwater Rearing Habitat

Tributaries to the Sacramento and San Joaquin rivers with year-round flows have the primary rearing habitat for CCV steelhead. 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. Freshwater rearing habitat has high value even if the current conditions are significantly degraded from their natural state.

2.2.2.1.3 Freshwater Migration Corridors

Migration corridors 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. 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 value even if the migration corridors are significantly degraded compared to their natural state.

2.2.2.1.4 Estuarine Areas

This PBF is outside of action area for the proposed action. The remaining estuarine habitat for this species is severely degraded by altered hydrologic regimes, poor water quality, reductions in habitat complexity, and competition for food and space with exotic species. Regardless of the condition, the remaining estuarine areas are of high value because they provide factors which function to provide predator avoidance, as rearing habitat and as an area of transition to the ocean environment.

2.2.2.2 Description of VSP Parameters

2.2.2.2.1 Abundance

Historic CCV steelhead run sizes are difficult to estimate given the paucity of data, but may have approached one to two million adults annually (McEwan 2001). By the early 1960s, the steelhead run size had declined to about 40,000 adults (McEwan 2001). Hallock *et al.* (1961) estimated an average of 20,540 adult steelhead through the 1960s in the Sacramento River upstream of the Feather River. Steelhead counts at the RBDD declined from an average of 11,187 for the period from 1967 to 1977, to an average of approximately 2,000 through the early 1990s, with an estimated total annual run size for the entire Sacramento-San Joaquin system, based on RBDD counts, to be no more than 10,000 adults (McEwan & 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 on a few rivers. 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.

Coleman National Fish Hatchery (CNFH) operates a weir on Battle Creek, where all upstream fish movement is blocked August through February, during the hatchery spawning season. Counts of steelhead captured at and passed above this weir represent one of the better data sources for the CCV DPS. Steelhead returns to CNFH have fluctuated greatly over the years. From 2003 to 2012, the number of hatchery origin adults has ranged from 624 to 2,968. Since 2003, adults returning to the hatchery have been classified as wild (unclipped) or hatchery produced (adipose clipped). Natural-origin adults counted at the hatchery each year represent a small fraction of overall returns, but their numbers have remained relatively steady, typically 200-500 fish each year, although numbers the past five years have been lower, ranging from 185 to 334 (NMFS 2016b).

Redd counts are conducted in the American River, with an average of 142 redds counted on the American River from 2002-2015 (data from Hannon & Deason 2008, Hannon *et al.* 2003, Chase 2010), with only 58 counted in 2015, a new low for this survey (NMFS 2016b).

The East Bay Municipal Utilities District has included steelhead in their redd surveys on the Lower Mokelumne River since the 1999-2000 spawning season, and the overall trend is a slight increase (2000 to 2010). 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 CCV 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, and stocking levels have remained fairly constant, 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. Data that is more recent shows a slight increase in the annual returns, which averaged 1,134 fish from 2011 to 2015 (CDFW 2015).

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 USFWS has steadily increased since 2001. The average redd index from 2001 to 2011 is 157, representing somewhere between 128 and 255 spawning adult steelhead on average each year. From 2011 through 2015, an average of 231 redds has been observed in Clear Creek. The vast majority of these steelhead are natural-origin fish, as no hatchery steelhead are stocked in Clear Creek, and adipose fin clipped steelhead are rarely observed in Clear Creek (NMFS 2016b).

Catches of steelhead at the fish collection facilities in the southern Delta are another source of information on the relative abundance of the CCV steelhead DPS, as well as the proportion of wild steelhead relative to hatchery steelhead. The overall catch of steelhead at these facilities has been highly variable since 1993. The percentage of unclipped steelhead in salvage has also fluctuated, but has generally declined since 100 percent clipping started in 1998. The number of stocked hatchery steelhead has remained relatively constant overall since 1998, even though the number stocked in any individual hatchery has fluctuated.

Overall, steelhead returns to hatcheries have fluctuated so much from 2001 to 2016 that no clear trend is present, other than the fact that the numbers are still far below those seen in the 1960's and 1970'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.

2.2.2.2.2 Productivity

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 CCV 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 (wild) 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.

Analysis of data from the Chipps Island midwater trawl conducted by the USFWS indicates that natural steelhead production has continued to decline, and that hatchery origin fish represent an increasing fraction of the juvenile production in the Central Valley. Beginning in 1998, all hatchery-produced steelhead in the Central Valley have been adipose fin clipped (ad-clipped). Since that time, the trawl data indicates that the proportion of ad-clipped steelhead juveniles captured in the Chipps Island monitoring trawls has increased relative to wild juveniles, indicating a decline in natural production of juvenile steelhead. The proportion of hatchery fish exceeded 90 percent in 2007, 2010, and 2011. 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.

Salvage of juvenile steelhead at the CVP and SWP fish collection facilities also indicates a reduction in the natural production of steelhead. The percentage of unclipped juvenile steelhead collected at these facilities declined from 55 percent to 22 percent over the years 1998 to 2010 (NMFS 2011b).

In contrast to the data from Chipps Island and the CVP and SWP fish collection facilities, some populations of wild CCV steelhead appear to be improving (Clear Creek) while others (Battle Creek) appear to be better able to tolerate the recent poor ocean conditions and dry hydrology in the Central Valley compared to hatchery produced fish (NMFS 2011b). Since 2003, fish returning to the CNFH have been identified as wild (adipose fin intact) or hatchery produced (ad-clipped). Returns of wild fish to the hatchery have remained fairly steady at 200-300 fish per year, but represent a small fraction of the overall hatchery returns. Numbers of hatchery origin fish returning to the hatchery have fluctuated much more widely, ranging from 624 to 2,968 fish per year. The Mokelumne River steelhead population is supplemented by Mokelumne River Hatchery production.

2.2.2.2.3 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). The extent of habitat loss for steelhead most likely was much higher than that for salmon because steelhead were undoubtedly more extensively distributed.

Steelhead are well distributed throughout the Central Valley below the major rim dams (Good *et al.* 2005; NMFS 2011b). 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.

The low adult returns to the San Joaquin tributaries and the low numbers of juvenile emigrants typically captured suggest that existing populations of CCV steelhead on the Tuolumne, Merced, and lower San Joaquin rivers are severely depressed. The loss of these populations would severely impact CCV steelhead spatial structure and further challenge the viability of the CCV steelhead DPS.

The NMFS Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014), includes recovery criteria for the spatial structure of the DPS which provide one viable population in the Northwestern California diversity group, two viable populations in the basalt and porous lava diversity group, four viable populations in the northern Sierra Nevada diversity group, and two viable populations in the southern Sierra Nevada diversity group, in addition to maintaining dependent populations, are needed for recovery.

Efforts to provide passage of salmonids over impassable dams have the potential to increase the spatial diversity of Central Valley steelhead populations if the passage programs are implemented for steelhead. In addition, the 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 CV spring-run Chinook salmon could also benefit CCV steelhead (NMFS 2011b).

2.2.2.2.4 Diversity

a. Genetic Diversity: CCV steelhead abundance and growth rates continue to decline, largely the result of a significant reduction in the amount and diversity of habitats available to these populations (Lindley *et al.* 2006). Reductions in population size are also supported by genetic analysis (Nielsen *et al.* 2003). Garza and Pearse (2008) analyzed the genetic relationships among CCV steelhead populations and found that, unlike the situation in coastal California watersheds, fish below barriers in the Central Valley were often 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 CCV 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 (CNFH, FRFH, Nimbus Fish Hatchery, and Mokelumne River Fish Hatchery) in the Central Valley, which combined release approximately 1.6 million 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.

b. 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.

Only winter-run (ocean maturing) steelhead currently are found in California Central Valley rivers and streams (Moyle 2002; McEwan & Jackson 1996). Summer-run steelhead have been extirpated due to a lack of suitable holding and staging habitat, such as cold-water pools in the headwaters of CV streams, presently located above impassible dams (Lindley *et al.* 2006).

Juvenile steelhead (parr) rear in freshwater for one to three years before migrating to the ocean as smolts (Moyle 2002). 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 *et al.* 1961, McEwan & Jackson 1996). In contrast 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)

2.2.2.3 Summary of DPS Viability

All indications are that natural CCV steelhead have continued to decrease in abundance and in the proportion of natural fish over the past 25 years (Good *et al.* 2005; NMFS 2011b); the long-term trend remains negative. Hatchery production and returns are dominant over natural fish. 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, CCV steelhead populations in the San Joaquin Basin continue to show an overall very 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 CCV 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 structure necessary for the DPS to survive and avoid localized catastrophes. However, as described in the recent 5-year Status Review (NMFS 2016b), most wild CCV populations are 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. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to wild fish. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead.

2.2.3 Climate Change

One major factor affecting the rangewide status of the threatened and endangered anadromous fish in the Central Valley and aquatic habitat at large is climate change.

Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen *et al.* 2000). Central California has shown trends toward warmer winters since the 1940s (Dettinger & Cayan 1995). An altered seasonality results in runoff events occurring earlier in the year due to a shift in precipitation falling as rain rather than snow (Roos 1991; Dettinger *et al.* 2004). Specifically, the Sacramento River basin annual runoff amount for April – July has been decreasing since about 1950 (Roos 1987, 1991). Increased temperatures influence the timing and magnitude patterns of the hydrograph.

The magnitude of snowpack reductions is subject to annual variability in precipitation and air temperature. The large spring snow water equivalent (SWE) percentage changes, late in the snow season, are due to a variety of factors including reduction in winter precipitation and temperature increases that rapidly melt spring snowpack (VanRheenen *et al.* 2004). Factors modeled by VanRheenen *et al.* (2004) show that the melt season shifts to earlier in the year, leading to a large percent reduction of spring SWE (up to 100% in shallow snowpack areas). Additionally, an air temperature increase of 2.1°C (3.8°F) is expected to result in a loss of about half of the average April snowpack storage (VanRheenen *et al.* 2004). The decrease in spring SWE (as a percentage) would be greatest in the region of the Sacramento River watershed, at the north end of the CV, where snowpack is shallower than in the San Joaquin River watersheds to the south.

Projected warming is expected to affect CV Chinook salmon, because the runs are restricted to low elevations as a result of impassable rim dams. If climate warms by 5°C (9°F), it is questionable whether any CV Chinook salmon populations can persist (Williams 2006). Based on an analysis of an ensemble of climate models and emission scenarios and a reference temperature from 1951 – 1980, the most plausible projection for warming over Northern California is 2.5°C (4.5°F) by 2050 and 5°C by 2100, with a modest decrease in precipitation (Dettinger 2005). Chinook salmon in the CV are at the southern limit of their range, and warming will shorten the period in which the low elevation habitats used by naturally-producing fall-run Chinook salmon are thermally acceptable. This would particularly affect fish that emigrate as fingerlings, mainly in May and June, and especially those in the San Joaquin River and its tributaries.

Spring-run Chinook salmon adults are vulnerable to climate change because they over-summer in freshwater streams before spawning in autumn (Thompson *et al.* 2011). Spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and those tributaries without cold water refugia (usually input from springs) will be more susceptible to impacts of climate change. Even in tributaries with cool water springs, in years of extended drought and warming water temperatures, unsuitable conditions may occur. Additionally, juveniles often rear in the natal stream for one to two summers prior to emigrating, and would be susceptible to warming water temperatures. In Butte Creek, fish are limited to low elevation habitat that is currently thermally marginal, as demonstrated by high summer mortality of adults in 2002 and 2003, and will become intolerable within decades if the climate warms as expected. Ceasing water diversion for power production from the summer holding reach in Butte Creek resulted in cooler water temperatures, more adults surviving to spawn, and extended population survival time (Mosser *et al.* 2013).

CCV steelhead will experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat, however, the effects may be even greater in some cases, as juvenile steelhead need to rear in the stream for one to two summers prior to emigrating as smolts. In the Central Valley, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 14°C to 19°C (57°F to 66°F). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than salmon (McCullough *et al.* 2001). In fact, McCullough *et al.* (2001) recommended an optimal incubation temperature at or below 11°C to 13°C (52°F to 55°F). Successful smoltification in steelhead may be impaired by temperatures above 12°C (54°F), as reported in Richter and Kolmes (2005). As stream temperatures warm due to climate change, the growth rates of juvenile steelhead could increase in some systems that are currently relatively cold, but potentially at the expense of decreased survival due to higher metabolic demands and greater presence and activity of predators. Stream temperatures that are currently marginal for spawning and rearing may become too warm to support wild steelhead populations.

In summary, observed and predicted climate change effects are generally detrimental to the species (McClure 2011; Wade *et al.* 2013), so unless offset by improvements in other factors, the status of the species and critical habitat is likely to decline over time. The climate change projections referenced above cover the time period between the present and approximately

2100. While there is uncertainty associated with projections, which increases over time, the direction of change is relatively certain (McClure *et al.* 2013).

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR § 402.02). The action area is not the same as the project boundary area because the action area must delineate all areas where federally listed fishes and their habitats may be affected by the implementation of the proposed action. The action area is located in the southwest portion of the City of Redding, Shasta County, California, approximately 3.5 miles west of Interstate-5. The action area is within Township 26, Section 31N, Range 5W of the Public Land Survey System. Using the World Geodic System 1984, it is located at Latitude: 40.51371 N; Longitude: -122.40763 W, between the Gold Dredge Trailhead and the China Garden Trailhead off of Clear Creek Road (Figure 1). The LCC FSCRP is bordered to the north by Clear Creek Road and to the south by the OHWM of Clear Creek, and bluffs. The LCC FSCRP will occur on lower Clear Creek between approximately RM 2.1 and 2.8. The entire action area is on BLM property. For the purposes of addressing potential direct and indirect effects of the proposed action on listed fish species and their designated critical habitat, the action area encompasses lower Clear Creek, between Whiskeytown Dam and Clear Creek's confluence with the Sacramento River. More specifically, it encompasses the upper extent of the project footprint on lower Clear Creek, the adjacent riparian zone, and approximately 300 feet downstream to capture turbidity impacts.

Areas affected directly will be those in the immediate project footprint and immediately downstream. Indirect effects of the LCC FSCRP are those effects that are caused by, or will result from, the proposed action and may occur later in time, but are still reasonably certain to occur (50 CFR §402.02). Indirect effects associated with the project are those related to noise, dust, and turbidity above ambient levels. To include indirect effects from noise and dust, the action area extends 100 feet beyond the construction footprint. During installation of the control feature, temporary river crossing (and removal), and redirection of Clear Creek flows through the new channel alignment, the action area also includes the extent to which instream turbidity may extend downstream, which is approximately 300 feet. In Section 401 of the Clean Water Act's Water Quality Certification, the CV Water Board typically requires measuring of turbidity levels 300 feet downstream of in-water activities to ensure they do not exceed turbidity thresholds for water quality.

2.4 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).

Clear Creek is a perennial stream that that drains an area of 238 square miles and originates in the Trinity Mountains northwest of the city of Redding, California, and terminates in the Sacramento River south of the city of Redding. Clear Creek is part of the Trinity River Division of the CVP, and receives diversions from the Trinity River through the Clear Creek Tunnel, which discharges some water into the Clear Creek watershed at the Judge Carr Powerhouse, while the rest is diverted and discharged into Keswick Lake at the Spring Creek Powerhouse, upstream of Whiskeytown Dam. Reclamation's operations of Whiskeytown Dam, which is located 18.1 miles upstream from Clear Creek's confluence with the Sacramento River, follow the CVPIA Anadromous Fish Restoration Project guidelines for temperature and streamflow releases to Clear Creek.

Whiskeytown Dam has presented an impassable fish barrier to anadromous fish since its completion in 1963. The reach downstream of Whiskeytown Dam is commonly referred to as lower Clear Creek, and is the geographical setting of this project. Lower Clear Creek flows from an elevation of approximately 1,000 feet above mean sea level (msl) at Whiskeytown Dam to 460 feet msl at the Sacramento River confluence. The area has a Mediterranean climate with cool, wet winters and hot, dry summers. Average precipitation is approximately 25 to 35 inches per year and falls mostly as rain. The average annual air temperature is approximately 62 ºF and the average frost-free period is approximately 200 to 250 days.

Gold was discovered at Reading Bar, approximately eight miles upstream from the Sacramento River confluence, in 1848. This discovery resulted in large-scale placer mining activities that occurred through the 1940s. Gold mining activities significantly affected hydrogeomorphological processes and aquatic habitat quality through the removal, processing, and redeposition of fluvial deposits. More recently, commercial aggregate mining in both the floodplain and stream channel contributed to the alteration and loss of fluvial deposits.

Whiskeytown Dam exacerbated these fluvial alterations by reducing gravel recruitment into Clear Creek. All sediment from the upper watershed is trapped by the reservoir, resulting in an alluvial sediment deficit and reduction in fish habitat quality (Coots 1971 as cited in McBain and Trush *et al.* 2001, Graham Matthews and Associates 2006). In addition to the reduction of sediment supply, recruitment of LWM to the stream channel and floodplain has also declined in Clear Creek due to a reduction in bank erosion and large flood flows downstream of Whiskeytown Dam.

McCormick-Saeltzer Dam was constructed in 1903, approximately six and a half miles upstream of the Sacramento River confluence to divert water for mining and agricultural irrigation. This created a partial barrier to fish migration that was compounded by a difficult passage through the bedrock stream channel immediately downstream of the dam. Few anadromous fish were known to have spawned above these passage impediments (Newton & Brown 2004).

The combination of degraded physical habitat characteristics, fish passage barriers, and changes in hydrology resulting from gold and aggregate mining, dams, and diversions since the mid-1800s was associated with the near-extirpation of anadromous fish in Clear Creek by the late 1900s. Upon implementation of CVPIA and Ecosystem Restoration Program sponsored projects in Clear Creek, habitat conditions and anadromous fish populations have continued to improve. In 1995, streamflows were increased and water temperature standards implemented in Clear

Creek to improve salmon and steelhead habitat. Suitable spawning and rearing habitat were identified as limiting factors for anadromous fish populations in Clear Creek, and as a result, gravel has been injected into Clear Creek on an annual basis since 2002, and instream habitat structures have also been installed at various locations. Juvenile spring-run Chinook from Feather River Hatchery were released into Clear Creek in 1991-1993. Coded-wire tagged adults returned from these releases in 1993 to 1996 including 26 in 1995 (Brown 1996). Genetic analysis suggests that strays from Butte Creek and Mill or Deer Creek have also recently spawned in Clear Creek. In addition, coded-wire tagged spring-run strays from Feather River Hatchery have been recovered after spawning in Clear Creek. McCormick-Saeltzer Dam was removed in the fall of 2000, and anadromous fish began using the 11.6 miles of stream upstream of the former dam site for spawning, rearing, and holding (Newton & Brown 2004).

A small (approximately 200 fish) but increasing number of spring-run Chinook salmon continues to spawn annually in Clear Creek (NMFS 2009). According to snorkel surveys by USFWS, up to approximately 660 (in 2013) individual spring-run Chinook salmon have continued to spawn annually in Clear Creek (S. Gallagher *pers. comm*.). As the issue of hybridization and redd superimposition between the fall/late-fall run and spring-run of Chinook salmon became a concern, these runs were segregated using a seasonally-installed weir beginning in 2002 to minimize spawning of the fall run in the same areas as the spring run. Steelhead spawning has also increased in Clear Creek. Anadromous fish populations in Clear Creek have improved relative to their Central Valley metapopulations since 2002. Anadromous fish escapement, redd counts, and carcass indices in Clear Creek have either increased, remained stable, or decreased significantly less than their Central Valley metapopulations in the years after implementation of habitat improvement activities.

Lack of spawning habitat continues to limit anadromous fish production in Clear Creek. However, in 2014 Reclamation received a Biological Opinion from NMFS on the *Lower Clear Creek Anadromous Fish Habitat Restoration and Management Project*, which involves restoration activities such as spawning gravel augmentation and placement of instream habitat structures in Clear Creek between Whiskeytown Dam and its confluence with the Sacramento River, through 2030 (NMFS 2014). This effort is a continuation of ongoing anadromous fish restoration efforts in Clear Creek authorized under the CVPIA, which seeks to restore fluvial sediment processes and improve habitat conditions for anadromous salmonid species. Previous phases (1, 2A, 2B, 3A, 3B) of the LCC FSCRP were completed between 1998 and 2008 to rehabilitate the channel to support anadromous salmonid species by reconstructing the bank full channel and floodplains, restoring sediment transport processes, restoring native riparian vegetation on floodplain and terrace surfaces, and reducing salmonid stranding and mortality in floodplain gravel extraction pits.

Within the action area, the majority of the existing Clear Creek channel alignment provides a range of poor to marginal riparian vegetation coverage, with superior riparian habitat upstream and downstream of the action area. Starting on the upstream end of the action area, Clear Creek is characterized by a wider channel with mature riparian vegetation on its banks and some areas of undercutting that then narrows significantly with steep slopes encouraging faster flows, and with little riparian vegetation on its banks. The channel hits a river bend then becomes wider with denser riparian vegetation along the banks. A small backwater channel towards the downstream end of the reach within the action area branches north to a pond that has been created by a beaver dam. This channel provides suitable rearing habitat with riparian vegetation cover. The pond contains water year-round and fills with Clear Creek overflow during high flows above 1,000 cfs. Spawning values in the action area are very low because much of the suitable spawning substrate (gravel) has migrated downstream, Whiskeytown Dam has blocked its natural replenishment, and the existing narrow channel with fast-moving water does not support redds. Within the action area, Clear Creek also has at least one foot of water during lower flows (~100 cfs), but can be lower in certain areas of concern, and provides fish passage.

2.4.1 Status of Species and Critical Habitat in the Action Area

The action area is within designated critical habitat for CV spring-run Chinook salmon and CCV steelhead. The action area functions as a migratory corridor for adult and juvenile spring-run Chinook salmon and steelhead, and as juvenile rearing habitat. Due to the life history timing of spring-run Chinook salmon and steelhead, it is possible for one or more of the following life stages to be present within the action area throughout the year: adult migrants, and rearing and emigrating juveniles. When Clear Creek flows are at approximately 500 cfs (reached during spring pulse flows and winter storms), there is approximately 0.67 mile of migratory corridor, 0.01 mile of deep pool habitat, and 0.46 mile of rearing habitat within the action area. The amount of available salmonid habitat in the action area during construction (measured at flows of 200 cfs) is approximately 0.58 miles, all of which allows fish passage (with some difficult spots where water is less than a foot deep), and approximately 0.48 miles of which provides juvenile rearing habitat.

2.4.1.1 Central Valley Spring-run Chinook Salmon

A number of past human activities impacted CV spring-run Chinook salmon. Dams have eliminated access to historic holding, spawning, and rearing habitat and have resulted in CV spring-run Chinook salmon and fall-run Chinook salmon spawning and rearing in the same areas, at the same times. This has resulted in increased competition, superimposition of redds, and interbreeding of the two populations. Other anthropogenic activities that have impacted CV spring-run Chinook salmon include modification of the hydrograph, loss of sediment and large wood transport, restriction of lateral movement of the river channel, mining, unscreened water diversions, and riparian vegetation removal.

Clear Creek has supported a small population of CV spring-run Chinook salmon, which has been monitored since 1998. The August adult index count has averaged less than 100 adults, with the highest count in the year 2008, of 200 adults, until the year 2012, which observed the highest count on record of 651 adults (Giovannetti *et al.* 2013). The removal of Saeltzer Dam in 2000 opened nearly 12 miles of access to areas just downstream of Whiskeytown Dam for a total of 18 miles for CV spring-run Chinook salmon and CCV steelhead. Adult CV spring-run Chinook salmon move through the action area in lower Clear Creek during their up-stream migration beginning mid-March to mid-August, peaking mid-April through June (Table 5) to the upper most reaches to spawn beginning early September and continue through early to mid-October. Adults hold in deep pools throughout Clear Creek until spawning commences in the upper most reaches of lower Clear Creek, beginning early September through early to mid-October (NMFS 2014: 50).

Table 5. Adult and Juvenile Salmonid Run Timing in Clear Creek, Shasta County, CA (USFWS 2016).

Species/Life Stage	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Adult spring-run Chinook salmon[1]												
Juvenile spring-run Chinook salmon[2]												
Adult fall-run Chinook salmon[3]												
Juvenile fall-run Chinook salmon[2]												
Adult late fall-run Chinook salmon[1]												
Juvenile late fall-run Chinook salmon[2]												
Adult CV steelhead[1, 3]												
Juvenile CV steelhead[2]												
Key:	= Salmonids expected to be present in greatest abundance				= Salmonids present but in lesser abundance							

Footnotes: [1]Clear Creek Video Station Monitoring. Dec 15 – Aug 15, 2013-2016. Red Bluff Fish and Wildlife Office; [2]Clear Creek Juvenile Salmonid Monitoring. Annual production estimates from rotary screw trapping, 1998-2016. Red Bluff Fish and Wildlife Office; [3]Clear Creek Video Station Monitoring, Aug 15-Dec 15, 2012-2016. California Department of Fish and Wildlife.

In 2009, NMFS issued the Biological and Conference Opinion on the *Long-Term Operation of the CVP and SWP*. Included in the Opinion is a reasonable and prudent alternative to conduct at least two pulse flows in Clear Creek in May and June to attract adult spring-run Chinook salmon to move to upstream Clear Creek habitats for holding and spawning purposes. In these habitats, spring-run Chinook salmon can access colder water temperatures, large holding pools, and clean spawning gravel. By migrating further upstream in lower Clear Creek, hybridization and competition with fall-run Chinook salmon (in lower Clear Creek closer to the confluence with the Sacramento River) will be lessened. USFWS monitoring has shown that pulse flows have been successful in attracting spring-run Chinook salmon into Clear Creek. The number of spring-run Chinook in Clear Creek increased 40 percent in 2013 and 66 percent in 2014 during pulse flows in June (USFWS unpublished data).

Since 2003, the USFWS has installed a temporary picket weir from late August through early November, to allow spring-run Chinook salmon a spatial separation from fall-run Chinook salmon, which otherwise have an overlap in spawning timing. The majority (85-95%) spawn upstream of the picket weir (river mile 7.4 - 8.2, approximately 6 river miles upstream of the action area) to Whiskeytown Dam (Newton & Brown 2004). Spawning habitat does not occur in the action area.

Juvenile emigration occurs November through June, but peak numbers pass USFWS's upper rotary screw trap on Clear Creek (which had just started running in 2013/2014) in November through January (S. Gallagher, *pers. comm*.). Rotary screw trap sampling also indicates that few spring-run Chinook salmon rear in Clear Creek beyond the spring following their emergence (Greenwald *et al.* 2003, Earley *et al.* 2008).

2.4.1.2 California Central Valley Steelhead

A significant portion of the CV steelhead DPS spawn and rear in the Sacramento River and its tributaries (Reynolds *et al*. 1993). Adult CV steelhead begin spawning in Clear Creek in early December and continue until about mid-March. Adult CV steelhead populations in Clear Creek have been relatively stable between 2003 and 2011 with redd counts ranging from 42 to 409, with an average of 176 (Giovannetti *et al.* 2013). Rotary screw traps have also been used to estimate juvenile production of steelhead in Clear Creek. Lower Clear Creek has a high value because it supports several life stage functions for CV steelhead such as spawning, rearing, and migration and because it has a high potential to support more fish through continued restoration.

A significant portion of the CV steelhead spawn and rear in the Sacramento River and its tributaries (Reynolds *et al*. 1993). Adult CV steelhead may enter the Sacramento River and its tributaries from July through March, but enter Clear Creek mid-September through June. Peak migration into Clear Creek occurs from mid-September to November. Spawning in Clear Creek occurs early December through mid-March, with peak spawning occurring from late January to early February (Giovannetti and Brown 2007). CV steelhead spawning occurs throughout lower Clear Creek from Whiskeytown Dam (RM 18.1) to River Mile 3 in the lower reach, which excludes the action area located downstream of River Mile 3. The action area lacks suitable spawning habitat and gravel. Fry emerge from February through June, with peak emergence between April and May (M. Brown, pers. comm.). Rearing and emigration of juveniles occur year-round in Clear Creek (Table 5 above), and the peak period of juvenile emigration is between March and June (Giovannetti and Brown 2008, Earley *et al.* 2009).

Adult CV steelhead spawning populations in Clear Creek have been relatively stable since 2003 with redd counts ranging from 43 to 409, with an average of 193 based on snorkel surveys from 2003 – 2017 (S. Gallagher, pers. comm.). Rotary screw traps have also been used to estimate juvenile production of steelhead in Clear Creek. Lower Clear Creek habitat is high value (significant habitat features) because it supports several life stage functions for CV steelhead such as spawning, rearing and migration and because it has a high potential to support more fish through continued restoration.

CV steelhead utilize the action area as a migratory corridor and potential holding rearing habitat. When Clear Creek flows are at approximately 500 cfs (reached during spring pulse flows and winter storms), there is approximately 0.67 mile of migratory corridor, 0.01 mile of deep pool, and 0.46 mile of rearing habitat within the action area.

2.4.1.3 Status of Critical Habitat

The action area is located in the CalWater Hydrologic Sub-Area 550810, which provides 98 miles of spawning/rearing, rearing/migration, and presence/migration PBFs for CV spring-run

ESU Chinook salmon and 153 miles of spawning/rearing and rearing/migration with 147 miles of presence/migration habitat for Central Valley ESU steelhead (NMFS 2004). The action area contains PBFs that support rearing and migration for Chinook salmon and steelhead. Spawning habitat does not occur in the action area.

Lower Clear Creek, including the project area, was designated as critical habitat for spring-run Chinook salmon on September 2, 2005 (70 FR 52488). Lower Clear Creek is characterized by alternating pools and riffles. The channel form, along with boulders, ledges, and turbulence, provides key characteristics supporting the PBFs of critical habitat (*i.e.*, spawning habitat is located upstream but not in the action area, freshwater rearing sites, and freshwater migration corridors). Lower Clear Creek has a high value (significant habitat features) because it supports several life stage functions for CV spring-run Chinook such as spawning, rearing and migration and because it has a high potential to support more fish through continued restoration. Spawning values in the action area are low because much of the suitable spawning substrate (gravel) has migrated downstream and Whiskeytown Dam has blocked its natural replenishment.

Steelhead critical habitat was designated September 2, 2005 (70 FR 52488). The PBFs of proposed critical habitat for steelhead within the action area are nearly identical to those for spring-run Chinook salmon. Therefore, the status of proposed critical habitat for steelhead can be considered the same as that provided above for spring-run Chinook salmon.

2.4.2 Factors Affecting Species and Critical Habitat in Clear Creek

The PBFs of critical salmonid habitat within the action area include: freshwater spawning habitat, freshwater rearing habitat, 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 value of the action area is high because its entire length is used for extended periods of time by federally listed fish species. These features have been affected by human activities such as water management, flood control, agriculture, and urban development throughout the action area.

There is evidence that Clear Creek may have supported all runs of Central Valley salmonids (Yoshiyama *et al.* 1996). A series of landscape perturbations (*i.e.*, gold mining, gravel extraction, and dam building) altered the channel morphology of Lower Clear Creek between Whiskeytown Dam and the Sacramento River drastically. Problems included loss of gravel bars, disconnected floodplain, channel scouring and entrenchment, degraded riparian vegetation, and fish stranding in isolated dredger ponds. Beginning in 1995, state and federal agencies together with the Western Shasta RCD and the Clear Creek CRM began site assessment and the development of a restoration plan to create a new bank full channel, functional floodplain, gravel supply, and native riparian vegetation. Work began in 1998 and was completed over a series of phases that involved reduction of salmon stranding, floodplain creation, instream channel improvements, and gravel supply augmentation.

Gravel mining within the watershed of lower Clear Creek has resulted in a reduction of salmon and steelhead habitat. The properly functioning condition of lower Clear Creek basin has been compromised to some extent in its ability to provide rearing habitat for juvenile salmonids, and as a corridor for migrating juvenile and adult salmonids. Carrying capacity and complexity of the habitat has decreased with removal of riverine trees and instream woody material, riprap actions or other modification to the embankment, and water diversion. The proposed fish habitat restoration and management project will allow natural processes to increase the ecological function of the habitat, while at the same time removing adverse impacts of past practices. The purpose of the proposed action is to further restore, enhance, and protect stream and riparian habitat suitability; and increase overall fish production of anadromous salmonids inhabiting Clear Creek.

2.4.2.1 Hydroelectric Development and Water Diversions

Clear Creek flows have been diverted into Whiskeytown Lake primarily for hydroelectric development. The habitat in lower Clear Creek is strongly influenced by Whiskeytown Dam operations. Construction of Whiskeytown Dam cut off most of the original salmonid habitat in Clear Creek by the early 1900s, and current operations of the dam continue to have an impact on salmon and steelhead by limiting the availability of water, particularly during periods of high human water demands.

2.4.2.2 Habitat Restoration

Clear Creek habitat restoration has been driven in large part by a Fisheries Management Plan (FMP) developed for Clear Creek. Reclamation developed an FMP in coordination with the lower Clear Creek technical advisory committee (TAC), a working group comprised of fishery biologists, geologists, and other river and land management specialists from CDFW, USFWS, NMFS, Reclamation, and BLM. The FMP balances instream flow and temperature requirements of spring-run Chinook salmon, fall-run Chinook salmon, and steelhead with the impact of operations on CVP objectives.

Habitat restoration in Clear Creek below the Whiskeytown Dam has occurred since the late 1990s. The CVPIA, and the goals of CALFED, have identified the lack of spawning gravel as a limiting factor for anadromous fish production in Clear Creek. Since 1995, the habitat restoration projects that have been implemented have contributed to significant increases in the numbers of anadromous fish spawning and rearing within Clear Creek. The sediment deficit and spawning habitat degradation downstream of Whiskeytown Dam have been addressed with channel and floodplain restoration projects and gravel injections of various types since 1996. Over 130,000 tons of spawning gravel has been added to Clear Creek downstream of Whiskeytown.

2.4.3 Conclusion: Likelihood of Species Survival and Recovery in the Action Area

CV spring-run Chinook salmon and California Central Valley steelhead utilize Clear Creek. Clear Creek has a high value for these species because of the location, and the habitat features provided that are essential to fulfilling nearly all of the fresh water life history requirements of these species. Improving population trends and ongoing habitat improvements to Clear Creek make it highly likely that these species will continue to survive and recover within the action area. The Central Valley Salmon and Steelhead Recovery Plan has indicated that populations of CV spring-run Chinook salmon and CV steelhead in Clear Creek are considered “Core 1” populations, which indicates that reaching viable status is achievable and needed for recovery of the ESU/DPS. Core 1 populations form the foundation of the recovery strategy and must meet the population-level biological recovery criteria for low risk of extinction, as described in the Recovery Plan (NMFS 2014).

2.5 Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR § 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

The effects 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 spring-run Chinook salmon and CCV steelhead. Due to the life history timing of spring-run Chinook salmon and steelhead, it is possible for the following life stages to be present in the action area: rearing and emigrating juveniles, and migrating adults.

To evaluate the effects of the LCC FSCRP (Phase 3C), NMFS examined the proposed components. We analyzed construction-related impacts, the likely effects of fish relocation efforts, and the expected fish response to habitat modifications. We also reviewed and considered Reclamation and BLM's proposed conservation and mitigation measures. This assessment relied heavily on the information from the joint BA project description, site visits (18 January 2018 & 13 March 2018), and discussions with consulting biologists and project engineers.

Specifically, the assessment will consider the potential short-term impacts related to listed species and critical habitat resulting from the construction impacts of the proposed action, including:

(1) potential for contaminants hazardous materials entering the water;

(2) increased turbidity and suspended sediment;

(3) potential mercury mobilization/methylation;

(4) temporal loss of riparian vegetation; and

(5) direct injury or death from in-channel work and relocation efforts.

Additionally, the assessment will consider the potential long-term beneficial effects to critical habitat from the rehabilitation of lower Clear Creek's natural stream channel and floodplain morphology. Beneficial effects include a more frequently inundated floodplain for juvenile salmonid rearing habitat, the creation of favorable habitat conditions (pools and riffles), improved passage at low flows, elimination of stranding in gravel pits, and long-term increase in riparian vegetation.

2.5.1 Construction Impact Analysis

NMFS expects that adult and juvenile CV spring-run Chinook salmon and CCV steelhead may be present in the action area during construction activities. Preferred spawning habitat is upstream of the action area, and is not typically utilized by spring-run Chinook salmon. However, any remaining downstream of the segregation picket weir would potentially spawn in the actin area. The work window of June 1, to September 30 may overlap with spring-run Chinook salmon downstream of the weir. Steelhead are not likely to spawn during this time period. This work window is outside the peak out-migration period for juvenile spring-run Chinook salmon and the migration period for steelhead. Some juvenile steelhead may be present in the construction zone during this work window; other conservation measures would be implemented to reduce the potential for adverse effects on juvenile steelhead.

Construction activities are expected to result in localized, temporary disturbance of aquatic habitat. Short-term effects are assessed based on the potential for exposure of listed species to construction-related effects and general knowledge of the impact mechanisms and species responses to these effects.

A small proportion of juvenile salmonids are likely to be exposed to the effects of construction activities will encounter short-term (*i.e.*, minutes to hours) construction-related noise, physical disturbance, and water quality impacts, resulting in injury or harm by increasing the susceptibility of some individuals to predation by temporarily disrupting normal behaviors and affecting sheltering abilities. Adult salmonids generally avoid areas of construction activity; any small numbers in the action area during construction are expected to temporarily move away to adjacent suitable habitat.

2.5.1.1 Accidental Spill of Hazardous Materials (Contaminants)

The large majority of Project activities would occur in exposed and dry portions of the creek; however, these activities would still be below the OHWM and any accidental contaminant spill, such as petroleum products from equipment, would thereby be within Clear Creek. The use of heavy equipment in, and near, the stream channel would increase the potential for an accidental spill of petroleum products, and other construction-related materials into the channel. Operation of construction equipment in or adjacent to the river presents the risk of a spill of hazardous materials into the river (*e.g.*, construction equipment leaking fluids). Toxic substances used at construction sites, including gasoline, lubricants, and other petroleum-based products could enter the waterway and have deleterious effects on listed salmonids and their prey. Potential effects of contaminants on fish include direct injury and mortality (*e.g.*, damage to gill tissue causing asphyxiation) or delayed effects on growth, reproduction, and survival (*e.g.*, increased stress or reduced feeding), depending on the type of contaminant and exposure concentrations. Petroleum products also tend to form oily films on the water surface that can reduce dissolved oxygen levels available to aquatic organisms. In addition, accidental spill of petroleum products would adversely affect PBFs of critical habitat.

The risk of such effects will be highest during in-water construction activities because of the proximity of construction equipment to the creek channel. However, this risk will be minimized by the implementation of a SPCCP, which is intended to prevent any discharge of oil into navigable water or adjoining shorelines. NMFS expects that implementation of the SPCCP will ensure that the potential for the release and exposure of construction-related contaminants will be avoided and/or minimized. Additionally, most of the construction will not be in-water and fishes will be removed and excluded from areas of in-water work prior to activities. These factors are expected to reduce the likelihood or severity of fuel spills or toxic compound releases to a point where they are not expected to cause adverse effects to any life stages of spring-run Chinook salmon or CCV steelhead.

2.5.1.2 Increased Turbidity and Suspended Sediment

Activities related to the construction of the new channel alignment, temporary access roads, temporary stream crossings, alcoves for rearing habitat, the logjam feature, vegetation removal, temporary installation of diversion dams and turbidity curtains, and temporary sorting and stockpiling of excavated materials would occur below the OHWM of Clear Creek. All of these activities will disturb the creekbed, resulting in temporary increases in turbidity and suspended sediments in the Action Area. The majority of the contractor use areas would be located below the OHWM. However, this area does not activate with flows during July through September (activates at 1,000 cfs). Based on expected conditions, approximately 20 percent of construction activities would occur in-water. This would involve a total of approximately 11,490 cy of wet excavation, and approximately 12,190 cy of in-water fill, which could increase turbidity and suspended sediment levels in lower Clear Creek. The approximately 80 percent of work that would not be in-water involves approximately 58,780 cy of excavation and 58,080 cy of fill and topsoil replacement.

The short-term increases in turbidity and suspended sediment levels associated with construction may negatively affect juvenile and adult CV spring-run Chinook salmon, fall-run Chinook salmon, and CV steelhead, and juvenile late fall-run Chinook salmon temporarily by causing fish to be stressed and avoid or leave preferred habitats. These impacts may negatively affect fish populations temporarily through reduced availability of food and reduced feeding efficiency leading to reduced growth rates, and exposure to sediment released into the water column. Fish responses to increased turbidity and suspended sediment can range from behavioral changes (*e.g.*, alarm reactions, abandonment of cover which could lead to predation, and avoidance) to sublethal effects (*e.g.*, reduced feeding rate), and, at high suspended sediment concentrations for prolonged periods, lethal effects (Newcombe & Jensen 1996). Temporary spikes in suspended sediment may result in behavioral avoidance of the site by fishes; several studies have documented active avoidance of turbid areas by juvenile and adult salmonids (Bisson & Bilby 1982, Lloyd *et al.* 1987, Servizi & Martens 1992, Sigler *et al.* 1984). Individual salmonids that encounter increased turbidity or sediment concentrations will likely move away from affected areas into suitable surrounding habitat.

High turbidity and suspended sediment levels can lead to reduced growth, survival, and reproductive success through a number of potential mechanisms such as reduced foraging ability, impaired disease resistance, and interference with cues necessary for orientation in homing and migration (Lloyd *et al.* 1987). Laboratory studies have demonstrated that chronic or prolonged exposure to high turbidity and suspended sediment levels can lead to reduced growth rates in juvenile salmonids. For example, Sigler *et al.* (1984) found that juvenile Coho salmon and steelhead trout exhibited reduced growth rates and higher emigration rates in turbid water (25-50

NTU) compared to clear water. Reduced growth rates in salmonids in turbid water have generally been attributed to their reliance on sight to effectively feed (Waters 1993).

Any increase in turbidity associated with instream work is likely to be brief and occur only in the vicinity of the site, attenuating downstream as suspended sediment settles out of the water column. During in-water work, turbidity will be monitored to remain within criteria established by the CV Water Board in the Clean Water Act, Section 401 Water Quality Certification obtained for the project. Requirements may include, but not be limited to, monitoring turbidity levels immediately upstream and approximately 300 feet downstream of in-water work every four hours to ensure they do not exceed turbidity criteria. Restricting these activities to the summer season (June 1 – September 30), when there are lower flows in Clear Creek, and implementing BMPs will help ensure that these activities will be short-term, localized, and minor.

2.5.1.3 Potential for Mercury Mobilization and Methylation

The inundation of floodplains play an important role in the methylation, mobilization, and transport of mercury. Water from the Clear Creek pond had tested high in methyl mercury there was concern that the levels of total mercury and methyl mercury were high in the sediments of this pond. The mercury source for this methylation process most likely comes from historic mining operations within the Clear Creek watershed. The construction of the Proposed Project has the potential to expose clay and silt sized particles which may have elevated mercury levels. These finer-sized sediments with elevated mercury could then be transported into the wetted channel of lower Clear Creek during high flow events. A fraction of the mercury may then methylate and become toxic to fishes and other biota in Clear Creek. Methylmercury has a range of toxic effects to fish including behavioral, neurochemical, hormonal, and reproductive changes. In one study of Atlantic salmon (*Salmo salar*), methylmercury caused altered behavior and pathological damage (Berntssen *et al.* 2003).

Reclamation, in collaboration with BLM, assessed the current total and methyl mercury levels in the sediment of a small, off channel, pond in the area of Phase 3C of the project (BOR 2016). To test for the levels of total mercury and methyl mercury in the pond sediments, a systematic sampling protocol was implemented to sample ten benthic sediment cores. Benthic samples targeted both the littoral (near-shore) zone and from the limnetic (open water) zone (Figure 2). In addition to the samples taken from the top 5 cm of each core, three additional sites were tested for total mercury and methyl mercury concentrations at depth. Results of this sampling will be used to help determine disposal, removal, reuse of sediment in the project area. On March 29-30, 2016 scientists collected sediment samples, at depth, using a hand deployed gravity corer. Samples from 10 sites were processed to represent possible variations spatially within the pond. All sites were sampled for sediments near the water interface (0-5 cm) additional sites were chosen to test for mercury concentrations at depth (5-15, and 15-30 cm). None of the samples resulted in the detection of total mercury above the reporting limit (RL = 0.33 mg/kg). All of the samples tested positive for methylmercury above the RL (RL = 0.0503 ng/g dry) ranging from 0.078 to 5.540 ng/g, averaging 1.228 ng/g. Samples from the 0-5 cm interface (1.603 ng/g, N=11) averaged higher than the results from the 5-15 cm depth (0.634 ng/g, N=3) and the 15-30 cm depth (0.242 ng/g, N=2).

Given existing conditions, water currently inundates and washes out the project area. No new areas of dredge tailings will be inundated as a result of the project. The Clear Creek watershed has a large amount of historical dredge tailings and the project area represents a small percentage of the total. Given these conditions, impacts to all life stages of CV spring-run Chinook salmon and CCV steelhead from increased mercury levels are not expected to occur.

2.5.1.4 Direct Injury or Death from In-channel Construction

In-water activities may cause direct injury or mortality to juvenile CV spring-run Chinook salmon and juvenile CV steelhead that could be in the action area. It is highly unlikely that adult CV spring-run Chinook salmon and adult CV steelhead would remain in the action area once construction activities commence. Diversion berms would be constructed in the existing channel to isolate in-water work associated with constructing the proposed channel alignment, alcoves, and the log jam, and to exclude fish from these areas. Fish from behind the diversion berms will be captured and relocated to avoid further effects. Initial construction of these control features and of the log jam and the alcoves could cause direct injury or mortality of through contact with equipment, entrapment, or burial. Juveniles, which are less able swimmers than adults, may be crushed if they are trapped by heavy equipment or materials and cannot escape. Conservation measures include operating equipment or placing materials in the active channel slowly and deliberately to encourage fish to move out of the in-water activity area, and repeating this after long periods of inactivity. Considering in-water work will occur in summer months when Clear Creek flows would be low and 80 percent of the action area below the OHWM will be dry and exposed, most construction activities along the proposed alignment would avoid direct effects to CV spring-run Chinook salmon and CV steelhead. However, a small proportion of juvenile salmonids exposed are expected to be injured as a result.

2.5.1.5 Fish Capture and Relocation Efforts

The access crossing over the backwater channel would be one of the first construction activities, to allow equipment access to the main work areas. This would occur prior to installation of the diversion berm and turbidity curtain downstream of the beaver dam where the small backwater channel connects with the main stem channel at higher flows (between 500 and 1,000 cfs). Although the backwater channel would be disconnected from the main channel during construction (< 300 cfs), there is the potential that adult and juvenile salmonids may have been stranded in those areas from the spring pulse flows. Removing standing water could result in adult and juvenile CV spring-run Chinook salmon and juvenile CV steelhead becoming stranded, crushed during installation of the crossing, or entrained in the water intake system during ponded water removal activities and cause injury or death. However, a block net will be walked through or electrofishing will be done in the pond and backwater area to rescue and relocate fish prior to the pumping of ponded water. Also, pumping of ponded water will only occur where construction areas have been isolated from the channel and after fish rescue and relocation efforts have been completed. Water intakes will be screened with mesh and covered with a perforated drum to prevent debris and aquatic organisms from entering the water intake system, according to NMFS's 1997 *Fish Screening Criteria for Anadromous Salmonids*.

Fish capture and relocation will take place by qualified fish biologists to minimize exposure to construction activities. The appropriate capture and relocation method will be determined by

NMFS-approved fish biologists and approved by NMFS prior to dewatering. The preferred capture and relocation method is seining, but if electrofishing is deemed appropriate and necessary for the efficient and successful removal of fish, the NMFS electrofishing guidelines (NMFS 2000) will be strictly followed. Up to two fish capture teams of two to four persons will be used to facilitate efficient fish removal, reduce handling time, lower physiological stress, and reduce potential mortality rates. Considering that CV spring-run Chinook salmon and CV steelhead may be moving through, holding or rearing in the action area during removal of standing water and diversion berm and turbidity curtain installation, there is potential for these species to be handled during fish rescue operations. Although capture/relocation activities are expected to reduce overall losses, it is possible that not all fishes will be captured, and some incidental injury or mortality to small numbers of juvenile fishes is expected to occur as result of dewatering, capture, handling, and relocation.

2.5.2 Effects of the Proposed Action to Critical Habitat and PBFs

Construction is expected to have short-term adverse effects to habitat quantity and quality, including effects on the PBFs of designated critical habitat of CV spring-run Chinook salmon and CCV steelhead. The PBFs affected include, 1) freshwater rearing habitat, and 2) freshwater migration corridors; no spawning habitat is present. The amount of available salmonid habitat in the project footprint during construction (measured at flows of 200 cfs) is approximately 0.58 miles, all of which allows fish passage (though shallow), and approximately 0.48 miles of which provides juvenile rearing habitat. The majority of LCC FSCRP activities would occur below the OHWM of Clear Creek; however, construction will occur over the summer months when flows are low, typically around 150 cfs between July and September, and up to 275 cfs in late September and mid-October. During this period, the activity areas below the OHWM of Clear Creek and on the floodplain within the project footprint are approximately 80 percent exposed and dry. The areas that are wet are in the downstream end of the new channel alignment where the pond and backwater channel are located and contain standing water, represent 20 percent of the project footprint. Therefore, in-water activities, defined as those that occur in the active, wet channel will only occur in 20 percent of the project footprint.

The pond and backwater channel that connects to the main active channel at high flows receive water from a combination of groundwater and overland flow during high winter/spring flows (greater than 500 cfs). The only in-water activities that would occur in June would be potential installation of a diversion berm at the confluence of the backwater channel with the main creek channel, fish and turtle rescue efforts, and installation of the stream crossing in the backwater channel in order to allow equipment access to start vegetation removal. Pulse flows in June could reach approximately 800 cfs, which are high enough to connect the pond and backwater channel to the main channel via overland flow, so the crossing will be designed to withstand these flows. Depending on the planned June pulse flow, the contractor will use discretion in the field to determine if the diversion berm will need to be removed prior to the pulse flow and re-established to isolate work areas when flows decrease.

2.5.2.1 Riparian Vegetation Removal and Revegetation

Approximately 5.3 acres of vegetation will be temporarily impacted and 8.7 acres will be permanently impacted for the construction of temporary access corridors, the new channel alignment, alcoves, logjam, and floodplain fill. Including the Alternative Stage, Stockpile, Processing Area, a total of 21.89 acres of vegetation would be removed. Vegetation removal activities would occur in upland-most areas first until after the pulse flows occur. However, the majority of vegetation removal will be from construction of the new channel alignment; therefore, the effect of vegetation clearing on rearing habitat will be much less due to the banks of the new channel remaining vegetated. Rerouting the channel to its proposed location would provide additional shading and food sources than the current channel alignment by planting additional high- and medium-density riparian plants along portions of the new channel embankments currently lacking structurally complex riparian vegetation.

Mature riparian vegetation will be avoided as much as feasible to maintain in-stream habitat structures, bank cover, and riparian connectivity for the new channel alignment. Some riparian vegetation, such as willow cuttings, will be preserved for replanting at the end of the project in fall. The majority of vegetation removal will be from the new channel alignment; however, the effect of vegetation clearing on rearing habitat will be mitigated by maintaining vegetated banks along the new channel and planting additional native riparian plants throughout the site. Any temporary habitat losses are expected to result in adverse effects to fishes, such as increased localized temperatures (*i.e.*, reduced shade), predation mortality due to loss of cover, and a reduction in food supply that could lead to reduced growth rates and contribute to lower survival. These losses are expected to be short-term (up to five years) given the proposed replanting schedule.

Riparian habitat, particularly shaded riverine aquatic cover, is important for rearing and out-migrating juvenile salmon because it provides overhead and instream cover from predation and enhances food production. Shade from the overhanging vegetation helps to cool in-river water temperatures and provides insects for fish to forage. Terrestrial insects that live on riparian vegetation fall into the river and provide an important food source for fishes. Riparian trees and shrubs will eventually end up in the river channel as floods erode the bank or sweep them from the floodplain. Once in the river channel, the stems, trunks, and branches become very important structural habitat components for aquatic life, including fishes. Many of the aquatic invertebrates that are primary food sources for juvenile salmon and steelhead live on woody debris. Large wood affects the hydraulics of flows around it, resulting in a more complex channel geomorphology and increasing the storage of spawning gravels. The loss of riparian vegetation will temporarily reduce rearing and holding habitat during construction, reduce food production and feeding rates for juveniles, as well as increase rates of predation. However, these adverse impacts are anticipated to be short-term and ultimately improve rearing and holding habitat following revegetation and maintenance efforts. The creation of riparian habitat is ultimately expected to provide a long-term beneficial effect to salmonids by creating a source of food, cover, and river shading.

To compensate for impacts to critical habitat, work will begin in the fall immediately following construction completion until mid-November, weather permitting. If necessary, remaining revegetation efforts will resume and complete in fall of the next year, and temporary access roads would then be revegetation within a year after that. All temporarily disturbed areas will be revegetated with native riparian species wherever riparian communities can be supported. The proposed channel alignment would also provide more shading and food sources than the current alignment as existing mature vegetation and understory will be retained along the banks of the new channel, and additional high- and medium-density riparian communities will be planted where the site currently lacks structurally complex riparian vegetation.

Fines separated from the excavated material will be reused to fill low points or clay hardpan areas in the floodplain to enhance plant development in revegetated areas. The LCC FSCRP would plant a total of approximately 11.9 acres of a mix of low to high density complex riparian vegetation and herbaceous riparian zones, for a net increase of 3.2 acres of riparian vegetation. Proposed riparian revegetation and planting in floodplain areas lowered to hydrologically support additional riparian communities and along the proposed channel would improve the overall quality and riparian connectivity throughout the Clear Creek floodplain, and support future growth of riparian communities. The current channel alignment would also be left in place as a backwater area during high flows, and islands and alcoves would be constructed in the proposed channel to increase rearing habitat surface area and food sources. Large wood features would also be installed in the channel, which would provide additional coverage for juvenile salmonids. While channel realignment, floodplain grading, and removal/replanting of vegetation would temporarily disturb existing habitat, the overall long-term effect of these actions would provide a substantial increase in the ecological values (*i.e.*, high-quality and total rearing area, habitat complexity, cover) of lower Clear Creek for spring-run Chinook salmon, steelhead, and other native fish and wildlife species in the Action Area.

2.5.2.2 Restoring Floodplain Connectivity and Inundation

The essential features of freshwater rearing and migration PBFs include adequate substrate, water quality, water quantity, water temperature, water velocity, shelter, food, riparian vegetation, space, and safe passage conditions. The intended conservation roles of these habitats are to provide appropriate freshwater rearing and migration conditions for juveniles and unimpeded freshwater migration conditions for adults. The LCC FSCRP is expected to have a positive effect on the salmonid critical habitat PBF of freshwater rearing habitat. Overbank flows combined with riparian vegetation are key to reestablishing in-channel complexity. In addition, restored channel complexity will enhance in-stream hyporheic exchange through bedforms, buffer temperature fluctuations, and provide temperature refugia for salmonids, significantly improving out-migrant survival during spring heat waves. Additionally, the LCC FSCRP is expected to have a positive effect on the salmonid critical habitat PBF of freshwater migration corridors, as it has been designed to improve passage (*i.e.*, provide necessary depth, more favorable water temperatures) and to address existing fish stranding areas with strategic recontouring of the floodplain of lower Clear Creek.

The creation and enhancement of frequently inundated floodplain to provide high quality juvenile salmonid rearing habitat is one of the goals of the project and is expected to have measureable benefits to the PBFs of freshwater rearing for salmonids. The suitability of aquatic habitat for juveniles depends on the presence of nearshore areas with shallow water, instream woody material, and aquatic and riparian vegetation. The LCC FSCRP will improve the functional value of and existing flow regime to listed fish populations by restoring river-floodplain connectivity. The lack of inundated floodplain habitat for rearing salmonids is a major limiting factor in the lower Clear Creek corridor.

In addition to restoring connectivity, the new connection will also enhance floodplain/off-channel habitat values by increasing the area and duration of floodplain inundation over a broader range of flows. Increasing the area and frequency of floodplain inundation will provide juvenile salmonids and other fishes with valuable feeding and resting habitat, concealment from predators, and refuge during high flows (Jeffres *et al.* 2008). Creation of floodplains, side channels, and other off-channel areas that increase habitat complexity and inundate more frequently will function as high quality juvenile rearing habitat. Increased residence time of water in floodplains allows for the production of macroinvertebrates that juvenile salmonids feed on, which will lead to increased growth, larger size at outmigration, and survival to the ocean.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR § 402.02). 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. Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the climate change section of the environmental baseline (Section 2.4.2.10).

Non-Federal actions that may affect the action area include habitat restoration activities, agricultural practices (*i.e.*, water withdrawals and diversions), adjacent mining activities, and increased population growth resulting in urbanization and development of floodplain habitats. These actions will occur without respect to whether the Restoration project is implemented, and there are statutes in place to control all these activities to minimize their detrimental impacts. No reasonably foreseeable future projects within the LCC FSCRP action area are known at this time. Implementation of the proposed action is not expected to result in significant cumulative effects, in combination with other projects, within or outside of the action area.

2.6.1 Habitat Restoration

Voluntary State or private sponsored habitat restoration projects may have short-term negative effects associated with in-water construction work, but these effects typically are temporary, localized, and the outcome is expected to benefit listed species and habitats.

2.6.2 Agricultural Practices

Non-Federal actions that may affect the action area include water diversions for irrigated agriculture, ongoing agricultural activities in the lower Clear Creek action area. Farming and ranching activities within or adjacent to the action area may have negative effects on water quality due to runoff laden with agricultural chemicals. Stormwater and irrigation discharges related to agricultural activities contain numerous pesticides and herbicides that may adversely affect salmonid reproductive success and survival rates (Dubrovsky *et al.* 1998, 2000; Daughton 2003). Grazing activities from cattle operations can degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which then flow into the receiving waters of the associated watersheds.

Water withdrawals and diversions may result in entrainment of individuals into unscreened or improperly screened diversions, and may result in depleted river flows that are necessary for migration, spawning, rearing, flushing of sediment from spawning gravels, gravel recruitment, and transport of LWM. Agricultural practices in and upstream of Clear Creek may adversely affect riparian and wetland habitats through upland modifications of the watershed that lead to increased siltation or reductions in water flow. Water withdrawals and diversions may result in entrainment of fishes into unscreened or improperly screened diversions, and may result in depleted river flows that are necessary for migration, spawning, rearing, sediment flushing from spawning gravels, gravel recruitment, and transport of large woody debris. Depending on the size, location, and season of operation, these unscreened agricultural 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 CV database were either unscreened or screened insufficiently to prevent fish entrainment (Herren & Kawasaki 2001).

2.6.3 Mining Activities

Increased water turbidity levels for prolonged periods of time may result from adjacent mining activities, and increased urbanization and/or development of riparian habitat, and could adversely affect the ability of young salmonids to feed effectively, resulting in reduced growth and survival. Turbidity may cause harm, injury, or mortality to juvenile Chinook or steelhead in the vicinity and downstream of the project area. High turbidity concentration can cause fish mortality, reduce fish feeding efficiency and decrease food availability (Berg and Northcote 1985, McLeay *et al.* 1984, NMFS 1996a). Future urban development may adversely affect water quality, riparian function, and stream productivity.

2.6.4 Urban Development

Future urban and/or rural residential development may adversely affect water quality, riparian function, and aquatic productivity. Increases in urbanization and housing developments can impact habitat by altering watershed characteristics, and changing both water use and stormwater runoff patterns. Increased growth will place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions, particularly those that are situated away from waterbodies, will not require Federal permits, and thus will not undergo review through the ESA Section 7 consultation process with NMFS.

Increased urbanization also is expected to result in increased recreational activities in the region. Recreational activities can potentially disturb the current riparian vegetation and/or listed fish in the active channel. Among the activities expected to increase in volume and frequency is recreational boating. Boating activities typically result in increased wave action and propeller wash in waterways. This potentially will degrade riparian and wetland habitat by eroding channel banks and mid-channel islands, thereby causing an increase in siltation and turbidity. Wakes and propeller wash also churn up benthic sediments thereby potentially re-suspension of contaminated sediments and degrading areas of submerged vegetation. This in turn will reduce habitat quality for the invertebrate forage base required for the survival of juvenile salmonids moving through the system. Increased recreational boat operation is anticipated to result in more contamination from the operation of gasoline and diesel powered engines on watercraft entering the associated water bodies.

2.7 Integration and Synthesis

The *Integration and Synthesis* section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminishes the value of designated or proposed critical habitat for the conservation of the species.

2.7.1 Summary of the Status of the Species and Critical Habitat

2.7.1.1 CV Spring-run Chinook Salmon

Lindley *et al.* (2007) stated that perhaps 15 of the 19 historical populations of spring-run Chinook salmon are extinct, with their entire historical spawning habitats behind various impassable dams. Those authors only considered Butte, Deer, and Mill Creeks as watersheds with persistent populations of Chinook salmon confirmed to be spring-run Chinook salmon, although they recognized that Chinook salmon exhibiting spring-run characteristics persist within the FRFH population spawning in the Feather River below Oroville Dam and in the Yuba River below Englebright Dam. The populations in Butte, Deer, and Mill creeks and in the Feather and Yuba rivers fall within the Northern Sierra Nevada diversity group. Butte and Deer creek spring-run Chinook salmon populations had recently been considered at a low risk of extinction, and the Mill Creek population at a moderate or low risk (Lindley et al. 2007), but in the last four years returning spring-run Chinook salmon have declined in these creeks. Other small populations of spring-run Chinook salmon continue to persist in this diversity group in Antelope and Big Chico creeks, albeit at an annual population size in the tens or hundreds of fish, with no returning mature adults in some years.

In addition, small populations of spring-run Chinook salmon occur in the Basalt and Porous Lava diversity group in the main stem of the Sacramento River and in Battle Creek. Although, similar to the Antelope and Big Chico creek populations, these populations are made up of only tens or hundreds of fish and may be dependent on strays from other populations, although the extent of this dependency is not known. Monitoring of the Sacramento River mainstem during spring-run Chinook salmon spawning timing indicates some spawning occurs in the river. Here, the potential to physically separate spring-run Chinook salmon from fall-run Chinook salmon is complicated by overlapping migration and spawning periods. Significant hybridization with fall-run Chinook salmon has made identification of a spring-run Chinook salmon in the mainstem very difficult to determine, and there is speculation as to whether a true spring-run Chinook salmon population still exists downstream of Keswick Dam. Although the physical habitat conditions downstream of Keswick Dam are capable of supporting spring-run Chinook salmon, some years have had high water temperatures resulting in substantial levels of egg mortality. Less than 15 redds per year were observed in the Sacramento River from 1989 to 1993, during September aerial redd counts (USFWS 2003). Redd surveys conducted in September between 2001 and 2011 have observed an average of 36 salmon redds from Keswick Dam downstream to the RBDD, ranging from three to 105 redds (CDFG, unpublished data, 2011). This is typically when spring-run spawn, however, these redds also could be early spawning fall-run. Therefore, even though physical habitat conditions may be suitable, spring-run Chinook salmon depend on spatial segregation and geographic isolation from fall-run Chinook salmon to maintain genetic diversity. With the onset of fall-run Chinook salmon spawning occurring in the same time and place as potential spring-run Chinook salmon spawning, it is likely to have caused extensive introgression between the populations (CDFG 1998). Lindley et al. (2007) concluded that these populations are entirely composed of strays as spring-run Chinook salmon had been extirpated from the entire diversity group. Battle Creek spring-run Chinook salmon are at an abundance level that makes the population vulnerable to extirpation from demographic stochasticity - random effects of variation in individual survival or fecundity with little or no environmental pressure (Shaffer 1981, Allendorf et al. 1997, McElhany et al. 2000). As such, the population would fall into the high risk of extinction category based on abundance, as described in Lindley et al. (2007).

Ephemeral populations of CV spring-run Chinook salmon are found in the Northwestern California Diversity Group in Beegum and Clear Creeks, and salmon have been observed in Thomes Creek during the spring, although monitoring in that creek has not been conducted consistently due to poor access and difficult terrain. Returning adult spring-run Chinook salmon population sizes in Beegum and Clear creeks have generally ranged from tens up to a few hundred fish. Habitat restoration in Clear Creek has improved conditions for spring-run Chinook salmon and the population has been responding positively to these improvements. The draft Central Valley Salmon and Steelhead Recovery Plan considers Clear Creek to be a core 1 population that will be capable of reaching viable status (NMFS 2009b).

Historically, the majority of spring-run Chinook salmon in the Central Valley were produced in the Southern Sierra Nevada Diversity Group, which contains the San Joaquin River and its tributaries. All spring-run Chinook salmon populations in this diversity group have been extirpated (Lindley et al. 2007). Current San Joaquin River Restoration Program plans are underway to establish spring-run Chinook salmon production in the San Joaquin River downstream of Friant Dam (U.S. District Court 2006).

With demonstrably viable populations in only one of four diversity groups that historically contained them, spring-run Chinook salmon fail the representation and redundancy rule for ESU viability (Lindley et al. 2007). The current distribution of viable populations makes spring-run Chinook salmon vulnerable to catastrophic disturbance. All three extant independent populations are in basins whose headwaters occur within the debris and pyroclastic flow radii of Mount Lassen, an active volcano that the USGS views as highly dangerous (Hoblitt et al. 1987). The current ESU structure is, not surprisingly, also vulnerable to drought. Even wildfires, which are of much smaller scale than droughts or large volcanic eruptions, pose a significant threat to the ESU in its current configuration. A fire with a maximum diameter of 30 km, big enough to burn the headwaters of Mill, Deer and Butte creeks simultaneously, has roughly a 10 percent chance of occurring somewhere in the Central Valley each year (Lindley et al. 2007).

2.7.1.2 California Central Valley Steelhead

CV steelhead were listed as threatened on March 19, 1998 (63 FR 3347). Their classification was retained following a status review on January 5, 2006, (71 FR 834) and again on August 15, 2011 (76 FR 50447). This DPS includes all naturally-spawned steelhead populations (and their progeny) in the Sacramento and San Joaquin Rivers and their tributaries (inclusive of and downstream of the Merced River), excluding steelhead from San Francisco and San Pablo Bays and their tributaries. Historically, steelhead were well distributed throughout the Sacramento and San Joaquin Rivers (Busby *et al*. 1996). Steelhead were found from the upper Sacramento and Pit River systems (now inaccessible due to Shasta and Keswick Dams), south to the Kings and possibly the Kern River systems (now inaccessible due to extensive alteration from water diversion projects), and in both east- and west-side Sacramento River tributaries (Yoshiyama *et al*. 1996). The present distribution has been greatly reduced (McEwan and Jackson 1996), with nearly all historic spawning habitat blocked behind impassable dams in many major tributaries, including in the Northwestern California (Clear Creek), the Basalt and Porous Lava (Sacramento, Pitt, and McCloud rivers), the northern Sierra Nevada (Feather, Yuba, American, and Mokelumne rivers), and the southern Sierra Nevada (Stanislaus, Tuolumne, Merced, Calaveras, and San Joaquin rivers) diversity groups (Lindley *et al*. 2007).

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

The only consistent data available on steelhead numbers in the San Joaquin River basin come from CDFG mid-water trawling samples collected on the lower San Joaquin River at Mossdale. These data indicate a decline in steelhead numbers in the early 1990s, which have remained low through 2002 (CDFG 2003). In 2004, a total of 12 steelhead smolts were collected at Mossdale (CDFG unpublished data).

Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries, including Antelope, Battle, Deer, and Mill creeks and the Yuba River. Small populations may also exist in Big Chico and Butte creeks. A few wild steelhead are produced in the American and Feather Rivers (McEwan and Jackson 1996). Steelhead redd surveys in Clear Creek observed the highest count in 2009, possibly due to restoration activities (S. Giovannetti and Brown 2009). Until recently, steelhead were thought to be extirpated from the San Joaquin River system. Recent monitoring has detected small self-sustaining populations of steelhead in the Stanislaus, Mokelumne, Calaveras, and other streams previously thought to be void of steelhead (McEwan 2001). It is possible that naturally spawning populations exist in many other streams; however, these populations are undetected due to lack of monitoring programs (IEPSPWT 1999).

Steelhead returns to the Battle Creek watershed constitute a significant portion of the CV steelhead DPS, and most of the Battle Creek return originates at the Coleman NFH. Differentiating abundance between hatchery- and natural-origin steelhead in Battle Creek has been reliably estimable since 2002, when the first full cohort of 100 percent marked hatchery fish returned to the Coleman NFH. Prior to that year, hatchery and natural steelhead in Battle Creek were not differentiable, and all steelhead were managed as a single, homogeneous stock. Abundance estimates of natural origin steelhead in Battle Creek from 2001 to 2009 ranged from 222 to 545 (mean of 387, std.=101). The abundance of hatchery produced steelhead returning to Coleman NFH from 2003 to 2009 ranged from 1,004 to 3,193 (avg. = 1,993, std.=763). These estimates of steelhead abundance include all variants of life history types of the species *Oncorhynchus 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 *Oncorhynchus 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.

2.7.1.3 Designated Critical Habitat

2.7.1.3.1 CV Spring-run Chinook Salmon

Composed of primary constituent elements that are essential for the conservation of the species including, but not limited to, spawning habitat, rearing habitat, migratory corridors, and estuarine areas. Most of the historic spawning and rearing habitat for spring-run Chinook salmon is above impassable dams as is the case for the Sacramento, Feather, Yuba, American, Mokelumne, Stanislaus, Tuolumne, Merced, and San Joaquin rivers. Current spring-run Chinook salmon spawning habitat largely occurs in areas that historically functioned as either rearing habitat or migratory corridors, or spawning habitat for fall-run Chinook salmon. In areas where the spawning distributions of fall and spring-run Chinook salmon overlap, the quality of spawning habitat used by spring-run Chinook salmon is diminished when fall-run Chinook salmon, which spawn later than but still during spring-run Chinook salmon spawning, arrive at the spawning grounds and physically disturb spring-run Chinook salmon redds during their redd construction. This competition for spawning habitat between spring-run and fall-run Chinook salmon, which is the result of dam construction, occurs on several Central Valley rivers.

Clear Creek is located in the northwestern California diversity group and provides suitable habitat for CV spring-run Chinook salmon, largely due to cool water releases out of Wiskeytown Dam. Lower Clear Creek is characterized by alternating pools and riffles. The channel form, along with boulders, ledges, and turbulence, provides key characteristics supporting the PBFs of critical habitat (*i.e.*, spawning habitat, freshwater rearing sites, and freshwater migration corridors). Lower Clear Creek has a high value (significant habitat features) because it supports several life stage functions for CV spring-run Chinook such as spawning, rearing and migration and because it has a high potential to support more fish through continued restoration. Spawning values in the action area are low because much of the suitable spawning substrate (gravel) has migrated downstream and Whiskeytown Dam has blocked its natural replenishment.

At the scale of the ESU of CVspring-run Chinook salmon, substantial habitat degradation and alteration also has affected the rearing, migratory, and estuarine areas used by spring-run Chinook salmon. Some general examples of how spring-run Chinook salmon critical habitat has been degraded include the direct loss of floodplain and riparian habitat, the loss of natural river function and floodplain connectivity through levee construction, and effects to water quality associated with agricultural, urban, and industrial land use. One specific example of degradation to estuarine habitats used by spring-run Chinook salmon is that human activities in the San Francisco Bay-Delta Estuary have caused the loss or conversion of more than 500,000 acres of tidal wetlands and thousands of acres of shoreline and stream habitat (http://sfep.abag.ca.gov/pdfs/fact_sheets/SF_Bay_Delta_Estuary.pdf).

Perhaps the most striking indication that the status of estuarine habitats used by spring-run Chinook salmon has been degraded is the collapse of the pelagic community in the Delta that has been observed in recent years (Sommer et al. 2007). It is not immediately clear how the changes in the Delta ecosystem affect spring-run Chinook salmon, but it is certain that substantial changes to spring-run Chinook salmon estuarine habitat are occurring. It should be noted that the area in which the pelagic organism collapse is occurring does overlap with spring-run Chinook salmon critical habitat in the Delta, but the area of collapse also occurs in areas of the Delta that are not designated as spring-run Chinook salmon critical habitat.

The current condition of critical habitat for the ESU of CV spring-run Chinook salmon is highly degraded, and does not provide the value necessary for the survival and recovery of the species.

2.7.1.3.2 CCV Steelhead

It is estimated that 80 percent of the historic spawning and rearing habitat for CCV 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 CCV 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 CCV steelhead is composed of PBFs 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 CCV steelhead PBFs are similar to the stressors described for CV spring-run Chinook salmon critical habitat and 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, while both CV spring-run Chinook salmon and CCV steelhead critical habitat include the Sacramento Delta Hydrological Unit, CCV steelhead critical habitat additionally includes 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 CCV steelhead critical habitat is degraded.

CCV steelhead habitat in Clear Creek is generally considered to be suitable similarly to CV spring-run Chinook salmon habitat described above.

2.7.2 Effects of the Action to Listed Species and the Environmental Baseline

The action area currently has a returning population of CV spring-run Chinook salmon and CCV steelhead. As described earlier (in *Status of the Species* Section 2.2), populations of CV spring-run Chinook salmon and CCV steelhead have experienced significant declines in abundance and available habitat in California’s Central Valley relative to historical conditions. 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 (Williams *et al.* 2016). This severe decline in populations 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 spring-run Chinook salmon and CCV steelhead will continue to be at risk. The current extinction risk for each species was described in section 2.2 above, concluding an improvement for CV spring-run Chinook salmon 2011 to 2014, but with increased concerns for 2015 to 2018 due to effects of severe drought, and a continued high risk of extinction for CCV steelhead.

2.7.2.1 Project Effects

As described in the effects section (Section 2.5), the proposed action is likely to adversely affect various life stages of CV spring-run Chinook and CCV steelhead, including rearing and emigrating juveniles, and migrating adults.

The impact of in-water work during channel realignment, fish capture and relocation efforts, and habitat structure placement has the highest likelihood to affect listed species. During construction, juvenile CV spring-run Chinook and CCV steelhead are the life stages most likely to be impacted. Stranding, injury, or death to individual fishes is likely to result from the dewatering and capture and relocation activities surrounding the construction area. A small proportion of the Clear Creek populations of these species is expected to be adversely affected.

Alignment of a new channel is likely to result in increased turbidity, although this effect will be temporary in nature. These construction effects may result in injury or death to salmonids due to physiological damage from avoidance activity, gill fouling, reduced foraging capability, and increased predation related to displacement of individuals away from the shoreline or at the margins or turbidity plumes. Depending on the life stage of the listed species, impacts from increased turbidity would vary. Juvenile and adult salmonids would have adjacent suitable habitat to temporarily move to if needed, and would experience minor impacts. Incubating eggs would be at the highest risk. However, with the measure to check for spawning and redds prior to gravel augmentation at each site, and to not proceed in sites that contain redds in place, this potential impact is expected to be avoided.

For juvenile and outmigrating salmonids, the proposed action will result in some short- and long-term adverse effects to individuals that are exposed to the project features along lower Clear Creek. For juvenile rearing salmonids, shoreline habitat conditions are temporarily worsened by the removal of native vegetation compared to the environmental baseline due to the loss of shade, cover, and food inputs.

Effects to migrating steelhead, migrating Chinook, and steelhead residents (outmigrating post-spawning adults) are not considered adverse because adult salmonids are unlikely to use the nearshore habitat that will be affected by this project, preferring deeper water instead. Furthermore, the project is not anticipated to cause an increase in predation or install any structural features that might impede adult migration.

Although steelhead and spring-run Chinook salmon have the potential to be exposed to hazardous materials as a result of the project, exposure is not expected due to BMPs and conservation measures in place. Pollution from hazardous materials and mercury methylation may occur as a result of the LCC FSCRP, however, BMPs and proper implementation of avoidance and minimization measures are expected to minimize effects to minor levels. These construction type actions will occur during summer and early fall months, when the abundance of individual salmon and steelhead is low and is expected to result in correspondingly low levels of exposure, injury, or death.

As a result of channel realignment, floodplain restoration, and placement of instream habitat structures, spawning and rearing habitats are expected to increase and improve for CV spring-run Chinook salmon and CCV steelhead. A long-term benefit of the continued project is that population abundances are expected to increase.

2.7.3 Aggregate analysis for the ESU/DPS as a whole

The implementation of floodplain restoration projects, specifically, the LCC FSCRP, Phase 3C was identified as a priority recovery action in the Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014). The “Effects of the Action” section of this opinion acknowledged and analyzed the potential effects of the habitat restoration project in lower Clear Creek. Effects of the implementation of the project are expected to result in adverse effects to listed salmonids fish in the action area. Most significant immediate and long-term effects of the habitat restoration project will be to improve overall conditions for listed salmonids by increasing and improving habitat. This improvement of habitat will be achieved through increasing rearing habitat, resulting in increased survival, growth, and fitness.

The Central Valley Salmon and Steelhead Recovery Plan has identified Clear Creek as a necessary (Core 1) population for recovery of the ESU/DPS. The adverse effects that are anticipated to result from the implementation are not the type or magnitude that would be expected to reduce appreciably the likelihood of both the survival and recovery of the affected species at the ESU/DPS level. VSP parameters of spatial structure, diversity, abundance, and productivity are not expected to be negatively affected past construction, but rather improved in the long term. Improvements are expected through enhancements to critical habitat quality, reduction in stranding potential, and improved passage opportunities, which will improve growth, survival, and production necessary for Clear Creek to support a population to reach a viable status. NMFS expects that any adverse effects of this project will be outweighed by the immediate and long-term benefits to species survival, and increasing abundance, produced by the improvement in habitat for spring-run Chinook salmon and steelhead.

2.7.4 Summary of Effects of the Action on Critical Habitat

Overall, the proposed project will not appreciably diminish the value of the rearing habitat PBFs for the conservation of CV spring-run Chinook salmon and CCV steelhead. The long-term effects of the LCC FSCRP are anticipated to be beneficial to designated critical habitat for these species.

Excavation and placement of instream habitat structures is expected to cause temporary increases in turbidity and deposit silt or sand into Clear Creek, which may temporarily degrade current rearing conditions. In addition, physical disturbance to rearing habitat is expected to occur during excavation and instream habitat structure placement. BMPs will be in place during implementation of the proposed project, including to minimize turbidity and isolate work areas. Implementation of these BMPs will ensure these potential effects remain minor.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of CV spring-run Chinook salmon or CCV steelhead, nor destroy or adversely modify their designated critical habitat.

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to Section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a 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 regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR § 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR § 402.02). Section 7(b)(4) and Section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows: incidental take of juvenile CV spring-run Chinook salmon and CCV steelhead as a result of the LCC FSCRP, in the form of harm, capture, injury, or death as a result of project implementation due to their exposure to construction in the action area during the scheduled work period each year.

Incidental take is expected to occur during site preparation, specifically during (1) the dewatering of the pond and associated fish capture and relocation efforts; and (2) construction activities related to channel creation, alcove creation, floodplain fill.

It is not practical to quantify or track the amount or number of individuals that are expected to be incidentally taken per species as a result of the proposed action. This is due to the variability associated with the response of listed species to the effects of the proposed action, the varying population size of each species, annual variations in the timing of spawning and migration, individual habitat use within the action area, and difficulty in observing injured or dead fish. However, it is possible to estimate the extent of incidental take by designating an ecological surrogates, and it is practical to quantify and monitor the surrogates to determine the extent of incidental take that is occurring.

The most appropriate threshold for incidental take are ecological surrogates of temporary habitat disturbance during the dewatering of the area, channel excavation, floodplain fill/grading, and riparian habitat removal (*i.e.*, riparian forest, scrub shrub, and SRA cover). The amount of incidental injury and mortality attributable to fish relocation varies depending on the method used, ambient conditions, and the experience of the field crew. The expected proportion of listed juveniles isolated in the pond area is low. As fish relocation activities will be conducted by qualified fisheries biologists following NMFS guidelines, direct effects to and mortality of juvenile salmonids during relocation activities is expected to be minimal (less than 10 percent).

The behavioral modifications or fish responses that result from the habitat disturbance are described below. NMFS anticipates incidental take will be limited to the following forms of juvenile CV spring-run Chinook salmon and CCV steelhead:

(1) Harm, injury or death resulting from turbidity increases, extending up to 100 feet from the bank and 1,000 feet downstream. Increases in turbidity are reasonably certain to result in harm to the species through modification or degradation of the PBFs for rearing and migration that will result physiological impacts (*i.e.*, to the gills of fishes), temporary displacement of individuals, reduced feeding and fitness, and death due to increased predation.

(2) Capture, injury or death within the area of the pond dewatered, including fish capture/relocation efforts, which may utilize seining or electrofishing to capture/relocate fishes.

(3) Harm from temporary and permanent physical disturbance to a total of approximately 29 acres due to the following proposed project features: proposed channel alignment (10.6 acres); created alcoves (1.0 acre); log jam control feature (1.1 acre); and floodplain earthwork (8.2 acres). Temporary effects within the project footprint include approximately 8 acres of ground disturbance for the creation of access roads (1.0 acre) and the alternative stage, stockpile, and processing area (7.0 acres). Modification or degradation of the PBFs for rearing and migration that will result in temporary

displacement of individuals, loss of cover, increased predation, and reduced growth due to decreased food inputs.

If any specific parameter of these ecological surrogates are exceeded, the anticipated incidental take levels described will be considered exceeded, triggering the need to reinitiate consultation.

2.9.2 Effect of the Take

In the opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to CV spring-run Chinook salmon and CCV steelhead, or destruction or adverse modification of their critical habitat.

2.9.3 Reasonable and Prudent Measures

"Reasonable and prudent measures" are nondiscretionary measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR § 402.02).

(1) Measures shall be taken by Reclamation and BLM to minimize sedimentation and turbidity plumes in the action area and their direct and indirect effects to listed species and their critical habitat.

(2) Measures shall be taken by Reclamation and BLM to minimize impacts to riparian vegetation in the action area and its direct and indirect effects to critical habitat.

(3) Measures shall be taken by Reclamation and BLM to ensure that contractors, construction workers, and all other parties involved with these projects implement the BMPs, and complete revegetation monitoring as detailed in the BA and this opinion.

(4) Measures shall be taken by Reclamation and BLM to monitor and provide NMFS with a report associated with completion of the proposed action.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and Reclamation and BLM must comply with them in order to implement the reasonable and prudent measures (50 CFR § 402.14). Reclamation or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR § 402.14). If terms and conditions are not followed, protective coverage for the proposed action would likely lapse.

(1) The following terms and conditions implement reasonable and prudent measure 1:

   a. BMPs shall be implemented to prevent soil erosion and sediment incursion into the active channel of Clear Creek. Straw bales, straw wattles and silt fences shall be installed at source sites for the project, as appropriate.

   b. Operation of heavy machinery in the active channel shall be minimized to avoid disturbance of substrates.

c. Turbidity and settleable solids shall be monitored according to water quality permits. If acceptable limits are exceeded, work shall be suspended until acceptable measured levels are achieved.

d. Disturbed areas adjacent to the active channel that are deemed unstable shall be vegetated with native plant species and/or mulched with certified weed-free hay upon project completion.

(2) The following terms and conditions implement reasonable and prudent measure 2:

a. Equipment used for the project shall be thoroughly cleaned off-site to remove any invasive plant material or invasive aquatic biota prior to use in the action area.

b. Environmentally sensitive areas, sensitive plant species and wetland areas shall be avoided during project activities to the maximum extent practicable. High visibility fencing shall be placed around these areas to minimize disturbance.

c. Soil and excavated material and/or fill material shall be stockpiled in existing clearings when possible.

(3) The following terms and conditions implement reasonable and prudent measure 3:

a. Reclamation and BLM shall provide a copy of this opinion to the construction crew, informing them of their responsible for implementing all requirements and obligations included in this document and for educating and informing all other contractors involved in the project as to the requirements of this opinion. A notification that the construction crew have been supplied with this information shall be provided to the reporting address below.

(4) The following terms and conditions implement reasonable and prudent measure 4:

a. Reclamation and BLM shall monitor vegetation plantings and conduct post-project maintenance for 10 years. Maintenance activities include conducting weed control, operating irrigation systems throughout the irrigation period, maintaining irrigation systems, debris removal, and replacing dead or severely stressed plants.

b. Reclamation and BLM shall submit to NMFS an annual report describing the incidental take resulting from the Proposed Project. This shall include any fishes captured and relocated during cofferdam/dewater activities. This report shall be filed not later than January 1, covering the instream construction window from the previous year. The report should be submitted to the following address:

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

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, conservation recommendations are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR § 402.02).

(1) Reclamation and BLM should minimize any potential take whenever possible, and implement practices that avoid or minimize negative impacts to salmon and steelhead, and their critical habitat.

(2) Reclamation and BLM should support and promote aquatic and riparian habitat restoration within Clear Creek and other watersheds, especially those with listed aquatic species. Practices that avoid or minimize negative impacts to listed species should be encouraged.

(3) Reclamation and BLM should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support Recovery Actions in the NMFS Salmonid Recovery Plan (NMFS 2014).

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

2.11 Reinitiation of Consultation

This concludes formal consultation for the LCC FSCRP.

As 50 CFR § 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) the amount or extent of incidental taking specified in the ITS is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action.

3. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT ESSENTIAL FISH HABITAT RESPONSE

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 Reclamation and descriptions of EFH for Pacific Coast Salmon (PFMC 2014) contained in the Fishery Management Plans (FMP) developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

EFH is designated under the Pacific Coast Salmon FMP, which includes the action area of the proposed action. EFH in the action area consists of adult migration habitat and juvenile rearing and migration habitat for the three Chinook salmon runs (spring-, fall-, and late fall-run Chinook salmon). Habitat Areas of Particular Concern (HAPCs) that may be either directly or indirectly adversely affected include (1) Complex Channels and Floodplain Habitats, and (2) Thermal Refugia. The other HAPCs for Pacific Coast Salmon, (3) Spawning Habitat, (4) Estuaries, and (5) Marine and Estuarine Submerged Aquatic Vegetation, are not present in the Action Area.

The potential for construction-related adverse effects to EFH in Clear Creek is reduced by the fact that the majority of construction will occur in the summer months when flows are low and the pond and backwater channel will not be connected to the active channel. Additionally 80 percent of the action area will not require in-water construction activities. The active channel would be affected only during construction of the plug, creation of the alcoves, and opening of the proposed channel to the main channel. Therefore, there would be potential for limited adverse effects in the areas of habitat currently available in the action area (0.5 acre).

3.2 Adverse Effects on Essential Fish Habitat

Construction activities would result in increased sedimentation, turbidity, and the potential for contaminants to enter the waterway. Channel grading would result in adverse effects to EFH due to temporary losses of riparian habitat and disturbance of natural substrate. Long-term effects of the Project are expected to include a net increase in the amount and quality of EFH within the action area.

Consistent with the ESA portion of this document, which determined that aspects of the proposed action would result in impacts to listed fish species and critical habitat, we conclude that aspects of the proposed action would also adversely affect EFH for Chinook salmon. Effects to the HAPCs listed in Section 3.1 were described in detail in Section 2.5 and subsections. A list of temporary and permanent adverse effects to EFH HAPCs is included in this EFH consultation. We conclude that the following adverse effects on EFH designated for Pacific Coast Salmon are reasonably certain to occur (affected HAPCs are indicated by number, corresponding to the HAPCs listed above in Section 3.1).

3.2.1 Sedimentation and Turbidity

- Reduced habitat complexity (1)
- Degraded water quality (1, 2)
- Reduction in aquatic macroinvertebrate production (1)

3.2.2 Contaminants and Pollution-related Effects

- Degraded water quality (1, 2)
- Reduction in aquatic macroinvertebrate production (1)

3.2.3 Removal of Riparian Vegetation

- Reduced shade (2)
- Reduced supply of terrestrial food resources (1)
- Reduced supply of LWM (1)

3.3 Essential Fish Habitat Conservation Recommendations

The following conservation recommendations are necessary to avoid, mitigate, or offset the impact of the proposed action on EFH:

(1) To protect HAPC #1 (Complex Channels and Floodplain Habitats), NMFS recommends that Reclamation and BLM adopt term and condition 1 (a, b, c, and d), 2 (a, b, and c), and 4 (a).

(2) To protect HAPC #2 (Thermal Refugia), NMFS recommends that Reclamation and BLM adopt T&C 4 (a).

Fully implementing the above listed EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, 550 acres of designated EFH for Pacific Coast Salmon.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, Reclamation and BLM must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation

Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5 Supplemental Consultation

Reclamation and applicant 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)).

4. 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.

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. Reclamation and BLM are the intended users of this opinion. Other interested users could include USFWS, CDFW, or DWR. Individual copies of this opinion were provided to Reclamation and BLM. The format and naming adheres to conventional standards for style.

4.2 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 3 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.

4.3 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 MSA implementing regulations regarding EFH, 50 CFR 600.

Best Available Information: This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH consultation 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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