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 No: WCR-2018-10454

August 17, 2018

Nancy A. Haley
California North Branch Office
U.S. Army Corps of Engineers
1325 J Street
Sacramento, California 95814-2922

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Yuba County Water Agency South Canal Diversion Water Supply and Fish Passage Enhancement Project

Dear Ms. Haley:

Thank you for your letter of July 31, 2018, 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 Yuba County Water Agency South Canal Diversion Water Supply and Fish Passage Enhancement Project.

This biological opinion (BO) is based on the final biological assessment, received by NMFS on July 31, 2018. Based on the best available scientific and commercial information, the BO 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. NMFS has also 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. The United States Army Corps of Engineers serves as the lead Federal Action Agency for the Proposed Action.

This letter also transmits NMFS's review of potential effects of the Proposed Action on essential fish habitat (EFH) for Pacific Coast Salmon, designated under the Magnuson-Stevens Fishery

Conservation and Management Act (MSA). This review was pursuant to section 305(b) of the MSA, implementing regulations at 50 CFR 600.920, and agency guidance for use of the ESA consultation process to complete EFH consultation. The document concludes that the project will adversely affect the EFH of Pacific Coast Salmon in the Action Area.

Please contact Tancy Moore in NMFS' West Coast Region, California Central Valley Office, at (916) 930-3605, or via email at Tancy.Moore@noaa.gov, if you have any questions concerning this section 7 consultation, or if you require additional information.

Sincerely,

for Barry A. Thom
Regional Administrator

Enclosure

cc: To the File 151422-WCR2018-SA00463

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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

Yuba County Water Agency South Canal Diversion Water Supply and Fish Passage Enhancement Project

National Marine Fisheries Service (NMFS) Consultation Number: WCR-2018-10454

Action Agency: United States Army Corps of Engineers

Affected Species and NMFS' Determinations:

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

Fishery Management Plan That Describes EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	No

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

Issued By:

for Barry A. Thom
Regional Administrator

Date: August 17, 2018

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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

The National Marine Fisheries Service (NMFS) prepared the biological opinion (BO) 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 (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available through NMFS' Public Consultation Tracking System https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts. A complete record of this consultation is on file at the NMFS California Central Valley Area Office.

1.1.1 Background Regarding the Proposed Action

The Yuba County Water Agency (YCWA) diverts water from the lower Yuba River through the South Canal Diversion (SCD) intake facility and the South Canal to provide water supplies for the irrigation of lands in southern Yuba County. The SCD intake facility was constructed on the south bank of the lower Yuba River just upstream of Daguerre Point Dam in 1985 and has operated since then. The SCD conveys water to the South Yuba Water District, Brophy Water District, Dry Creek Mutual Water Company, and Wheatland Water District (collectively referred to as the South Member Units). The South Member Units provide this water to their farmers for irrigation of lands covering approximately 35,000 acres. Diversions from the lower Yuba River through the SCD typically are initiated by May 1 of each irrigation season, with peak diversions occurring in mid-summer.

In January and February 2017, two high flow events on the Yuba River with peak river flows exceeding 90,000 cubic feet per second (cfs) damaged YCWA's SCD intake facility and significantly altered the landscape of the river adjacent to and upstream of the facility. In the spring of 2018, runoff in the Yuba River watershed resulted in two events that each produced peak river flows in the lower Yuba River of over 40,000 cfs. These spring 2018 flows further altered the channel configuration adjacent to the SCD, including the further development of the middle channel, but did not alleviate the constriction in the south channel that was the result of the 2017 high-flow events.

Based on the configuration of the lower Yuba River in May 2018, the constriction that developed in the south channel during the 2017 high flows still required removal to allow increased flow through the south channel to the SCD. In June 2018, YCWA submitted the required permit applications to USACE in order to perform this work.

On June 21 and 22, 2018, a contractor for the South Yuba Water District (SYWD) conducted some work in the lower Yuba River upstream of the SCD without following all permitting requirements. This work included some removal of gravel and a partial excavation of the constriction in the south channel. Late in the day on June 22, a CDFW warden directed the contractor to stop this work. The contractor followed this direction and has not done any work in the south channel since then. On July 3, 2018, YCWA contractors completed a new bathymetry survey to quantify the extent of the changes in the south channel that resulted from the SYWD actions and to determine if the Proposed Action was still needed to alleviate the constriction in the south channel. Data from the new bathymetry survey determined that additional excavation work is necessary to ensure that there will be sufficient flows in the south channel for both anadromous fish passage and South Canal irrigation demands that are supplied by water diverted through the SCD during the rest of 2018, and to minimize necessary maintenance work at the site in 2019.

1.2 Consultation History

- February 22, 2018: YCWA Fisheries Consultants Keith Whitener and Mike Bryan (Robertson-Bryan, Inc.) met with Howard Brown and Gary Sprague of NMFS to discuss the project need and initial alternatives.

- March 27, 2018: YCWA fisheries consultant Keith Whitener conducted a site visit with Gary Sprague and Jean Castillo of NMFS, Beth Lawson and Jonathon Mann of CDFW, Robert Chase of USACE, Scott Matyac of YCWA, and YCWA engineering consultant John Christensen to discuss proposed alternatives and review modeling data.

- April 4, 2018: YCWA fisheries consultant Keith Whitener had a teleconference with Jean Castillo of NMFS and Beth Lawson and Jonathon Mann of CDFW to discuss modeling results and next steps regarding selection of a Proposed Action.

- May 3, 2018: YCWA Fisheries Consultants Keith Whitener and Mike Bryan conducted a site visit with Gary Sprague and Jean Castillo of NMFS, Beth Lawson and Jonathon Mann of CDFW, Scott Matyac of YCWA, and YCWA engineering consultant John Christensen to select an alternative to advance, discuss approaches to meeting various agency criteria and consultation. This site visit concluded with the decision to move the "medium riffle enhancement project" forward to the permitting and environmental documentation phase of the project.

- March 14 – May 14, 2018: Email exchanges occurred between YCWA Fisheries Consultants Keith Whitener and Mike Bryan, Gary Sprague and Jean Castillo of NMFS, Beth Lawson and Jonathon Mann of CDFW, Scott Matyac of YCWA, and YCWA engineering consultant John Christensen. These email exchanges discussed various

agency concerns related to meeting criteria, modeling results, site visit preparation, and project description elements.

- June 11, 2018: an ENG 4345 form, Biological Assessment and Essential Fish Habitat Assessment, and Alternatives Analysis for the YCWA Water Supply and Fish Passage Enhancement Project was submitted to the USACE. YCWA also submitted a wetland delineation report to the USACE on June 22, 2018. These documents constituted YCWA's application package for a Letter of Permission (LOP) from the USACE to authorize the Proposed Action under section 404 of the Clean Water Act.

- July 24, 2018: YCWA staff, their external legal counsel, and RBI staff met with USACE staff to discuss YCWA's need to construct the Proposed Action in 2018. RBI staff were directed to revise the project description to incorporate changes based on SYWD's work and to coordinate with NMFS staff to revise the Biological Assessment, as needed.

- July 26, 2018: RBI staff met with NMFS staff to discuss necessary revisions to the draft Biological Assessment.

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). The Proposed Action is the issuance of a permit by the USACE for the completion of the proposed work. Construction is planned to occur as soon as all permit and environmental approvals are received by YCWA, which is anticipated to be as early as August 6, 2018 but could continue as late as September 15, 2018, and will last up to two weeks. The Proposed Action will include: 1) mobilization, 2) constructing temporary access to the upstream gravel bar, 3) constructing a temporary road on the upstream gravel bar and directly in the south channel of the lower Yuba River to facilitate construction activities, 4) removal of river alluvium from south channel of the lower Yuba River to maintain the flow capacity, and spreading of excavated river alluvium on the adjacent gravel bar, if necessary, 5) placement of large woody debris in the excavated channel to aid in fish passage, 6) maintenance in 2019, if needed, to maintain enhanced flows in the south channel for water supply and fish passage, 7) removal of all temporary fill and demobilization, and 8) avoidance and minimization measures. Restoration of in-channel temporary project components will occur naturally by high winter flow events.

1.3.1 Mobilization

Before initiation of construction activities, YCWA's contractor will mobilize to the project site. In addition to mobilizing construction equipment, the contractor will erect construction signage and re-establish the staging areas that were created during previous 2017 emergency repair work. Existing USACE warning and portage signs located on the south bank of the river will be relocated to a location to be determined by USACE operations staff.

1.3.2 Construction of a Temporary Access Road to the Upstream Gravel Bar

Clearing the area for construction of access to the upstream gravel bar will require clearing and grubbing of approximately 185 linear feet of riparian vegetation located above the ordinary high water mark (OHWM). Vegetation to be removed includes sandbar and arroyo willows (*Salix interior and Salix lasiolapis*), white alders (*Alnus rhombifolia*), Fremont's cottonwoods (*Populus fremontii subsp. fremontii*), dense blackberry (*Rubus ursinus*), and wild grape (*Vitis californica*). All vegetation to be removed is separated from the river bank by approximately 30–50 feet. Most of the removed vegetation will be disposed at an existing off-river disposal area located approximately 0.3 mile due south of Daguerre Point Dam. Three trees will be used as large woody debris habitat in the excavated channel, as described below. All trees removed during the clearing of vegetation will be replaced in the area of removal at a 3:1 ratio.

Following vegetation and debris clearing, a 285 feet long by 30 feet wide (18 foot carriageway and two with 6 feet wide by 2 feet. high safety berms each side), temporary single lane construction access road will be constructed by placing fill material and grading the area where the vegetation was removed and continuing upstream, to the edge of the river bank. The footprint of the temporary construction access road will be approximately 0.21 acre and construction will require approximately 550 CY of imported dredge material that will temporarily be placed above the OHWM. The dredge material will be sourced from an existing stockpile area created during the 2017 emergency repairs of the SCD, located approximately 0.3 mile due south of Daguerre Point Dam.

Construction equipment needed to construct the temporary access road to the upstream gravel bar include a John Deere 450 Hydraulic excavator, 35 ton and 40 ton off-road dump trucks, water truck, and a D-8 bulldozer.

Upon completion of the Proposed Action, the temporary fill will be removed using an excavator, and stored at the existing stockpile area created during the 2017 emergency repairs of the SCD, located in the uplands approximately 0.3 mile due south of Daguerre Point Dam. Once all temporary fill material has been removed, the project area will be regraded to pre-project conditions.

1.3.3 Construction of a Temporary Road on the Upstream Gravel Bar and in the Lower Yuba River

Construction of a temporary road on the upstream gravel bar and directly in the south channel of the lower Yuba River is necessary to facilitate the instream removal of river alluvium from the south channel of the lower Yuba River.

A short temporary connecting ramp will be constructed from the bottom of the upland access road, described above, down onto the gravel bar. In the winter and spring, a small channel that is fed via seepage through the upstream gravel bar flows at the toe of the training embankment. However, during the construction period (August 6 – September 15) this channel will be dry due to decreasing water surface elevations in the river. The access ramp will be constructed using fill material that was graded down during construction of the temporary access road, if available, and

dredge material stockpiled from the 2017 emergency repair work that is stored at the offsite stockpile site.

The portion of the temporary construction road on the gravel bar (i.e., in the dry) will be approximately 215 feet long and 30 feet wide (18 foot carriageway with two 6 feet wide side berms) and will be constructed using dredge tailings stockpiled from the 2017 emergency repair project and local river alluvium. The portion of the temporary construction road in the lower Yuba River (i.e., in the wet) will be approximately 161 feet long and 30 feet wide (18 foot carriageway with two 6 feet wide side berms) and will be constructed using imported 3 in to 12 in diameter cobble material with gravel dressing, if needed. The total footprint of the temporary access road on the gravel bar, including the portions constructed both in the wet and in the dry, will be approximately 0.46 acre, with approximately 1,850 CY of dredge material temporarily placed below the OHWM. Construction equipment needed to construct the temporary access road to the upstream gravel bar include a John Deere 450 Hydraulic excavator, 35 ton and 40 ton off-road dump trucks, water truck, and a D-8 bulldozer.

Upon completion of the project, all temporary fill will be removed using an excavator and stored at the existing stockpile area created during the 2017 emergency repairs of the SCD, located in the uplands approximately 0.3 mile due south of Daguerre Point Dam. Once all temporary fill material has been removed, the project area will be regraded to pre-project conditions.

1.3.4 Excavation of River Alluvium from the South Channel of the Lower Yuba River and Spreading of River Alluvium on Adjacent Gravel Bar, if Necessary

Excavation of a portion of the south channel of the lower Yuba River is necessary to remove the constriction in order to re-create enough hydraulic flow capacity for this channel to supply the SCD and to provide fish passage through this channel. The south channel requires a minimum hydraulic capacity of about 350 cfs to supply the SCD with sufficient water under spring and summer flow conditions. To accomplish this, the excavated channel is expected to be about 447 feet long, 40 feet wide at the invert with 2H/1V side slopes with a water depth of 2 to 3 feet. The channel will be lined with river cobbles in the size range of 3 inch to 12 inch diameter.

As part of constructing the new channel, areas that were excavated during SYWD's work in the south channel must be filled in, thus the Proposed Action includes both cut and fill. The area of cut and fill is approximately 0.68 acre. Approximately 1,390 CY of river alluvium will be excavated from the channel, but 890 CY of that material will be used to fill areas excavated by SYWD in order to create the necessary hydraulics for increased flow and fish passage. 1,400 CY of 3 -12 inch cobbles will be placed back into the newly excavated channel to serve as channel lining to prevent erosion. Some of the cobble will be sourced from the excavated material and supplementary cobble material will be imported from Western Aggregate, as needed. All of the excavated river alluvium is expected to be used to fill in areas that were excavated by SYWD or used as channel lining. If there is excess alluvium, or if hydraulic factors prove it is necessary, excess alluvium is expected to be spread on the adjacent gravel bar. However, the exact configuration of the excavated channel cross section and thus whether material will be spread on the adjacent gravel bar will depend on hydraulic factors including channel configuration, channel length, available hydraulic gradient and channel surface roughness.

River alluvium will be excavated from the south channel using a long-arm excavator operating from the temporary road, adjacent to and within the south channel. All river alluvium excavated from the south channel and not used as fill or channel lining will be placed in trucks and spread on the adjacent gravel bar so as to be re-entrained into the river bedload during future high flow events. At the completion of the project, restoration of temporary in-channel excavation work will occur naturally by high winter flow events.

1.3.5 Placement of Large Woody Debris in the Excavated Channel

Upon completion of the excavation activities, large woody debris (LWD) will be placed into the excavated channel to reduce water velocities and aid fish in migrating through the south channel. Large woody debris will be spaced approximately 125 feet apart and secured in place by partial burial and bolstering with imported large rock. A total of three units of LWD will be placed into the excavated channel, and will cover an area of approximately 0.02 acre.

1.3.6 Maintenance of Excavated Channel

After higher flows have been restored to the south channel in 2018, it is possible that following winter flows of 2018/2019, the channel may become plugged again with debris or sediment or otherwise stop functioning as designed. If, following construction, the excavated channel no longer achieves the project objectives due to inadequate flow into the south channel, maintenance activities may be necessary. Maintenance activities could range from removal of deposited river alluvium similar to what is proposed for 2018 to removal of minor amounts of debris from the excavated channel. Maintenance, if necessary, is expected to be completed using an excavator and could require one to ten days of construction activities, depending on the level of maintenance required. Maintenance would be completed between June 15 and September 15, 2019.

1.3.7 Removal of all Temporary Fill, Restoration, and Demobilization

After all repair and maintenance activities are completed, clean-up activities will include: removal of any trash, debris, and construction materials, equipment, and signage. All temporary fill that was imported to the project site will be removed and taken back to the off-channel storage site located in the uplands approximately 0.3 mile south of Daguerre Point Dam. Restoration of the temporary excavated channel will occur naturally from winter high-flow events and, thus, will not require in-river work with heavy construction equipment. Re-grading of staging and storage areas, if necessary, and revegetation of disturbed areas will occur upon completion of all construction activities. All trees removed during construction will be replaced at a 3:1 ratio.

1.3.8 Avoidance and Minimization Measures

The following avoidance and minimization measures will be incorporated into YCWA's project activities to reduce impacts to ESA-listed species and their critical habitats. These avoidance and

minimization measures (AMMs) will also assist in mitigating the potential environmental effects during construction.

AMM 1: Timing of In-Water Work to avoid and minimize impacts on ESA-listed species, the following measures will be implemented:

- Construction of the project will occur between August 6, 2018 and September 15, 2018, and maintenance will occur June 15 to September 15, which are time periods when listed fish species are least likely to be affected by construction activities.
- Construction work will occur only during daylight hours, which would leave the nighttime hours for fish to migrate past the project site.
- Construction equipment will be moved into the south channel and allowed to idle for five minutes at the initiation of daily in-water construction activities in order to allow fish to move out of the area.
- The project will be completed as quickly as possible.

AMM 2: Construction best management practices (BMPs)

- All stockpiling of materials will occur outside the Waters of the United States WOUS in upland areas with limited ruderal vegetation or other potential habitat and, to the extent feasible, the project applicants will confine clearing of vegetation to the minimal areas necessary for the repair activities.
- Staging and temporary and long-term material disposal areas will be located away from any WOUS.
- Movement of heavy equipment to and from the project site will be restricted to established roadways and haul routes to the extent feasible to minimize habitat disturbance, and equipment will be stored in established staging areas.
- After completion of construction activities, any temporary fill and construction debris will be removed and disturbed areas will be restored to pre-project conditions. The temporary fill will be stored at the existing stockpile area created during the 2017 emergency repairs of the SCD, located in the uplands approximately 0.3 mile due south of Daguerre Point Dam.
- At all times, appropriate types and sufficient quantities of materials will be maintained on-site to contain any spills or inadvertent releases of materials that could cause a condition of pollution or nuisance if the materials were to reach WOUS or other waters. Fueling, lubrication, maintenance, storage, and staging of vehicles and equipment will be conducted in a manner that will prevent discharges to any WOUS.
- If any repair-related contaminants do reach any surface waters, appropriate spill response procedures will be initiated as soon as the incident is discovered. In addition, the State Water Resources Control Board staff contact person identified in the Water Quality Certification will be notified via email and telephone within 24 hours of the occurrence.
- Dust will be controlled utilizing water trucks. YCWA's contractors will use water trucks to patrol, water and condition all haul roads, staging areas, and active material placement locations within the project site, as needed.
- Contractors will be required to equip all internal combustion engine equipment with intake and exhaust mufflers that are in good condition and appropriate for the machines.

AMM 3: Turbidity Control

- River turbidity levels will be controlled using permeable turbidity curtain placed in the south channel, downstream of the entrance to the SCD channel. The permeable turbidity curtain will float six inches off of the bottom of the channel to allow for fish passage. In addition, the turbidity curtain will be removed from the channel at the conclusion of each in-water work day and reinstalled prior to the subsequent in-water work day.
- All turbidity control and monitoring requirements included in the CDFW 1600 and RWQCB 401 permit will be closely adhered to.

AMM 4: Erosion and Sediment Control

- All feasible avoidance and minimization measures will be implemented to control erosion and runoff from areas associated with construction activities. All areas of temporary impacts and all other areas of temporary disturbance which could result in a discharge to WOUS will be restored. Restoration activities will include grading of disturbed areas to pre-project contours, use of straw waddles or other erosion control avoidance and minimization measures, and revegetation with native species.
- YCWA's activities will not cause any impairment to beneficial uses of the lower Yuba River, including the uses specified in the Central Valley Water Quality Control Plan.

AMM 5: Construction Site Clean-up

- The revegetation palette will not contain any plants listed on the California Invasive Plant Council Invasive Plant Inventory, which can be accessed online at: http://www.calipc.org/ip/inventory/weedlist.php.
- Repair materials and debris from all repair work areas will be removed following completion of the project.

1.3.9 Interrelated and Interdependent Actions

"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). NMFS is not aware of any interrelated or interdependent actions.

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 BO includes both a jeopardy analysis and/or 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 BO 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 designation(s) of critical habitat for (species) use(s) 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 BO, 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 rangewide status of the species and critical habitat expected 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, suggest a RPA to the Proposed Action.

2.2 Rangewide Status of the Species and Critical Habitat

This BO 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. 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 BO also examines the condition of critical habitat throughout the designated area, evaluates the conservation 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 conservation value.

The following Federally listed species evolutionarily significant units (ESU), distinct population segment (DPS) and designated critical habitat occur in the Action Area and have the potential to be affected by the action (Table 1):

Table 1. ESA Listing History.

Species	**ESU or DPS**	**Original Final FR Listing**	**Current Final Listing Status**	**Critical Habitat Designated**
Chinook salmon (*Oncorhynchus tshawytscha*)	Central Valley spring-run ESU	9/16/1999 64 FR 50394 Threatened	6/28/2005 70 FR 37160 Threatened	9/2/2005 70 FR 52488
Steelhead (*O. mykiss*)	California Central Valley DPS	3/19/1998 63 FR 13347 Threatened	1/5/2006 71 FR 834 Threatened	9/2/2005 70 FR 52488

2.2.1 Central Valley Spring-run Chinook Salmon

- Listed as threatened (September 16, 1999, 64 FR 50394), reaffirmed (June 28, 2005, 70 FR 37160).
- Designated critical habitat (September 2, 2005, 70 FR 52488)

The Federally listed ESU of Central Valley (CCV) spring-run Chinook salmon and designated critical habitat for this ESU occurs in the Action Area and may be affected by the Proposed Action. Detailed information regarding ESU listing and critical habitat designation history, designated critical habitat, ESU life history, and VSP (viable salmonid population) parameters can be found in NMFS 2014 Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook salmon, Central Valley Spring-Run Chinook salmon, and the Distinct Population Segment of California Central Valley steelhead.

Historically, spring-run Chinook salmon were the second most abundant salmon run in the Central Valley and one of the largest on the west coast (CDFG 1990). These fish occupied the upper and middle elevation 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 1872, Rutter 1904, Clark 1929). 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).

Monitoring of the Sacramento River mainstem during spring-run Chinook salmon spawning timing indicates some spawning occurs in the river (CDFW, unpublished data, 2014). Genetic introgression has likely occurred here due to lack of physical separation between spring-run and fall-run Chinook salmon populations (CDFG 1998). Sacramento River tributary populations in Mill, Deer, and Butte creeks are likely the best trend indicators for the CV spring-run Chinook salmon ESU. Generally, these streams have shown a positive escapement trend since 1991, displaying broad fluctuations in adult abundance (CDFW 2016). The Feather River Fish Hatchery (FRFH) spring-run Chinook salmon population represents an evolutionary legacy of populations that once spawned above Oroville Dam. The FRFH population is included in the ESU based on its genetic linkage to the natural spawning population, and the potential for development of a conservation strategy (June 28, 2005, 70 FR 37160).

The Central Valley Technical Review Team (TRT) 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 (Lindley *et al.* 2004). Of these populations, only three independent populations currently exist (Mill, Deer, and Butte creeks tributary 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). In the San Joaquin River basin, observations in the last decade suggest that spring-running populations may currently occur in the Stanislaus and Tuolumne rivers (Franks 2015).

The CV spring-run Chinook salmon ESU is composed of two known genetic complexes. Analysis of natural and hatchery 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 by introgression with the fall-run ESU (Good *et al.* 2005a, Garza *et al.* 2007, Cavallo *et al.* 2011).

Because the populations in Butte, Deer and Mill creeks are the best trend indicators for ESU viability, we can evaluate risk of extinction based VSP in these watersheds. Over the long term, these three remaining populations are considered to be vulnerable to anthropogenic and naturally occurring catastrophic events. The viability assessment of CV spring-run Chinook salmon conducted during NMFS' 2010 status review (NMFS 2011), found that the biological status of the ESU had worsened since the last status review (2005) and recommended that the species status be reassessed in two to three years as opposed to waiting another five years, if the decreasing trend continued. 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 was conducted in 2015 (NMFS 2016b), which looked at promising increasing populations in 2012-2014; however, the numbers of returning fish in 2015 were extremely low (1,488), with additional pre-spawn mortality reaching record lows. Since the effects of the 2012-2015 drought have not been fully realized, we anticipate at least several more years of very low returns, which may result in severe rates of decline (NMFS 2016b).

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). CV 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).

Summary of the Central Valley Spring-run Chinook Salmon ESU Viability

In summary, the extinction risk for the CV spring-run Chinook salmon ESU remains moderate (NMFS 2016b). Based on the severity of the drought and the low escapements as well as increased pre-spawn mortality in Butte, Mill, and Deer creeks in 2015, there is concern that these CV spring-run Chinook salmon strongholds will deteriorate into high extinction risk in the coming years based on the population size or rate of decline criteria (NMFS 2016b).

Critical Habitat and Physical or Biological Features for Central Valley Spring-run Chinook Salmon

The critical habitat designation for CV spring-run Chinook salmon lists the PBFs (June 28, 2005, 70 FR 37160), which are described in NMFS 2014 Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook salmon, Central Valley Spring-Run Chinook salmon, and the Distinct Population Segment of California Central Valley steelhead. In summary, the PBFs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine habitat. The geographical range of designated critical habitat includes stream reaches of the Feather, Yuba, and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, and the Sacramento River, as well as portions of the northern Delta (June 28, 2005, 70 FR 37160).

Summary of the Value of CV Spring-run Chinook salmon Critical Habitat for the Conservation of the Species

Currently, many of the PBFs of CV spring-run Chinook salmon critical habitat are degraded, and provide limited high quality habitat. Features that lessen the quality of migratory corridors for juveniles include unscreened or inadequately screened diversions, altered flows in the Delta, scarcity of complex in-river cover, and the lack of floodplain habitat. Although the current conditions of CV spring-run Chinook salmon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species.

2.2.2 California Central Valley Steelhead

- Originally listed as threatened (March 19, 1998, 63 FR 13347); reaffirmed as threatened (January 5, 2006, 71 FR 834).
- Designated critical habitat (September 2, 2005, 70 FR 52488).

The Federally listed distinct population segment (DPS) of California Central Valley (CCV) steelhead and designated critical habitat for this DPS occurs in the Action Area and may be affected by the Proposed Action. Detailed information regarding DPS listing and critical habitat designation history, designated critical habitat, DPS life history, and VSP parameters can be found in the NMFS 2014 Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook salmon, Central Valley Spring-Run Chinook salmon, and the Distinct Population Segment of California Central Valley steelhead.

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 CCV steelhead run size had declined to about 40,000 adults (McEwan 2001). Current abundance data for CCV steelhead is limited to returns to hatcheries and redd surveys conducted on a few rivers. The hatchery data is the most reliable because redd surveys for steelhead are often made difficult by high flows and turbid water usually present during the winter-spring spawning period. CCV steelhead returns to Coleman National Fish Hatchery (NFH) have increased over the last four years, 2011 to 2014. After hitting a low of only 790 fish in 2010, the last two years, 2013 and 2014, have averaged 2,895 fish. Wild adults counted at the hatchery each year represent a small fraction of overall returns, but their numbers have remained relatively steady, typically 200–300 fish each year. Numbers of wild adults returning each year have ranged from 252 to 610 from 2010 to 2014.

Redd counts are conducted in the American River and in Clear Creek (Shasta County). An average of 143 redds have been counted on the American River from 2002–2015 [data from Hannon *et al.* (2003), Hannon and Deason (2008), Chase (2010)]. An average of 178 redds have been counted in Clear Creek from 2001 to 2015 following the removal of Saeltzer Dam, which allowed steelhead access to additional spawning habitat. The Clear Creek redd count data ranges from 100-1023 and indicates an upward trend in abundance since 2006 (USFWS 2015).

The returns of CCV steelhead to the Feather River Hatchery experienced a sharp decrease from 2003 to 2010, with only 679, 312, and 86 fish returning in 2008, 2009 and 2010, respectively. In recent years, however, returns have experienced an increase with 830, 1797, and 1505 fish returning in 2012, 2013 and 2014 respectively. Overall, steelhead returns to hatcheries have fluctuated so much from 2001 to 2015 that no clear trend is present.

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). Nobriga and Cadrett (2001) used the ratio of adipose fin-clipped (hatchery) to unclipped (wild) steelhead smolt catch ratios in the USFWS 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. Trawl data indicate that the level of natural production of steelhead has remained very low since the 2011 status review, suggesting a decline in natural production based on consistent hatchery releases. Catches of steelhead at the fish collection facilities in the southern Delta are another source of information on the production of wild steelhead relative to hatchery steelhead (CDFW data: ftp.delta.dfg.ca.gov/salvage). The overall catch of steelhead has declined dramatically since the early 2000s, with an overall average of 2,705 in the last 10 years. The percentage of wild (unclipped) fish in salvage has fluctuated, but has leveled off to an average of 36 percent since a high of 93 percent in 1999.

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). Many historical populations of CCV steelhead are entirely above impassable barriers and may persist as resident or adfluvial rainbow trout, although they are presently not considered part of the DPS. Steelhead are well-distributed throughout the Central Valley below the major rim dams (Good *et al.* 2005, NMFS 2016a). Most of the steelhead populations in the Central Valley have a high hatchery component, including Battle Creek (adults intercepted at the Coleman NFH weir), the American River, Feather River, and Mokelumne River.

California Central Valley 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). Recent reductions in population size are supported by genetic analysis (Nielsen *et al.* 2003). Garza and Pearse (2008) analyzed the genetic relationships among Central Valley 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, placing the natural population at a high risk of extinction (Lindley *et al.* 2007). Steelhead in the Central Valley historically consisted of both summer-run and winter-run migratory forms. Only winter-run (ocean maturing) steelhead currently are found in California Central Valley rivers and streams as summer-run have been extirpated (McEwan and Jackson 1996, Moyle 2002).

Although CCV steelhead will experience similar effects of climate change to Chinook salmon in the Central Valley, as they are also blocked from the vast majority of their historic spawning and

rearing habitat, 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.

Summary of California Central Valley Steelhead DPS viability

All indications are that natural CCV steelhead have continued to decrease in abundance and in the proportion to hatchery fish over the past 25 years (Good *et al.* 2005, NMFS 2016a); the long-term trend remains negative. Hatchery production and returns are dominant. Most wild CCV populations are very small 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.

In summary, the status of the CCV steelhead DPS appears to have remained unchanged since the 2011 status review, and the DPS is likely to become endangered within the foreseeable future throughout all or a significant portion of its range (NMFS 2016a).

Critical Habitat and Physical or Biological Features for California Central Valley Steelhead

The critical habitat designation for CV spring-run steelhead lists the PBFs (June 28, 2005, 70 FR 37160), which are described in NMFS 2014 Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook salmon, Central Valley Spring-Run Chinook salmon, and the Distinct Population Segment of California Central Valley steelhead. In summary, the PBFs include freshwater spawning sites; freshwater rearing sites; freshwater migration corridors; and estuarine areas.. The geographical extent of designated critical habitat includes: the Sacramento, Feather, and Yuba rivers, and Deer, Mill, Battle and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries but excluding the mainstem San Joaquin River above the Merced River confluence; and the waterways of the Delta.

Summary of the Value of California Central Valley Steelhead Critical Habitat for the Conservation of the species

Many of the PBFs of CCV steelhead critical habitat are currently degraded and provide limited high quality habitat. Passage to historical spawning and juvenile rearing habitat has been largely

reduced due to construction of dams throughout the Central Valley. Levee construction has also degraded the value for the conservation of the species of freshwater rearing and migration habitat and estuarine areas as riparian vegetation has been removed, reducing habitat complexity, food resources, and resulting in many other ecological effects. Contaminant loading and poor water quality in Central California waterways poses threats to lotic fish, their habitat and food resources. Additionally, due to reduced access to historical habitats, genetic introgression is occurring because naturally-produced fish are interacting with hatchery-produced fish which has the potential to reduce the long-term fitness and survival of this species.

Although the current conditions of CCV steelhead critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in the Sacramento/San Joaquin River watersheds and the Delta are considered to have high intrinsic value for the conservation of the species as they are critical to ongoing recovery effort.

2.2.3 Global Climate Change

One factor affecting the range-wide status of CCV steelhead and CV spring-run Chinook, and aquatic habitat at large is climate change.

The world is about 1.3°F warmer today than a century ago and the latest computer models predict that, without drastic cutbacks in emissions of carbon dioxide and other gases released by the burning of fossil fuels, the average global surface temperature may rise by two or more degrees in the 21st century (IPCC 2007). Much of that increase likely will occur in the oceans, and evidence suggests that the most dramatic changes in ocean temperature are now occurring in the Pacific (Noakes *et al.* 1998). Using objectively analyzed data Liu and Huang (2000) estimated a warming of about 0.9°F per century in the Northern Pacific Ocean.

Sea levels are expected to rise by 0.5 to 1.0 meters in the northeastern Pacific coasts in the next century, mainly due to warmer ocean temperatures, which lead to thermal expansion much the same way that hot air expands. This will cause increased sedimentation, erosion, coastal flooding, and permanent inundation of low-lying natural ecosystems (*e.g.*, salt marsh, riverine, mud flats) affecting listed salmonid PBFs. Increased winter precipitation, decreased snow pack, permafrost degradation, and glacier retreat due to warmer temperatures will cause landslides in unstable mountainous regions and destroy fish and wildlife habitat, including salmon-spawning streams. Glacier reduction could affect the flow and temperature of rivers and streams that depend on glacier water, with negative impacts on fish populations and the habitat that supports them.

Summer droughts along the South Coast and in the interior of the northwest Pacific coastlines will mean decreased stream flow in those areas, decreasing salmonid survival and reducing water supplies in the dry summer season when irrigation and domestic water use are greatest. Global warming may also change the chemical composition of the water that fish inhabit: the amount of oxygen in the water may decline, while acidity and salinity levels may increase. This will allow for more invasive species to overtake native fish species and impact predator-prey relationships (Petersen and Kitchell 2001, Stachowicz *et al.* 2002).

In light of the predicted impacts of global warming, the Central Valley has been modeled to have an increase of between 2 and 7 degrees Celsius by 2100, with a drier hydrology predominated by rainfall rather than snowfall (Dettinger 2004, Hayhoe *et al.* 2004, VanRheenen 2004, Stewart *et al.* 2005). This will alter river runoff patterns and transform the tributaries that feed the Central Valley from a spring and summer snowmelt dominated system to a winter rain dominated system. It can be hypothesized that summer temperatures and flow levels will become unsuitable for salmonid survival. The cold snowmelt that furnishes the late spring and early summer runoff will be replaced by warmer precipitation runoff. This will truncate the period of time that suitable cold-water conditions exist downstream of existing reservoirs and dams due to the warmer inflow temperatures to the reservoir from rain runoff. Without the necessary cold water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures downstream of reservoirs, such as Lake Shasta, could potentially rise above thermal tolerances for juvenile and adult salmonids that must hold and/or rear downstream of the dam over the summer and fall periods.

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 for the Proposed Action includes the project footprint and the area downstream where construction activities can temporarily decrease water quality, impacting listed fish species.

The Action Area includes construction footprint, which is 447 feet long, and the area 1,013 downstream until Daguerre Point Dam, for a total Action Area of 1,500 linear feet of the Yuba River. The Action Area also includes the SCD facility, which is located on the south bank of the lower Yuba River, approximately 1,000 feet upstream of Daguerre Point Dam. Finally, the Action Area includes the uplands located adjacent to the SCD where an access road will be constructed and staging areas and the existing access road to the stockpile area are located. The Action Area encompasses 7.40 acres, which includes 1.45 acres located in the uplands above the OHWM where the access roads are located and 5.95 acres located in the lower Yuba River channel below the OHWM. Due to the BMPs in place, it is not expected that impacts from the project (turbidity, contaminants, noise, etc.) will extend past Daguerre Point Dam. Since Daguerre Point Dam represents the upstream extent of the range of the Southern Distinct Population Segment of the North American green sturgeon, sturgeon have been excluded from this consultation.

2.4 Environmental Baseline

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

2.4.1 Historical Usage of the Lower Yuba River

The lower Yuba River has undergone significant morphological and ecological changes over the past 150 years due to a sequence of anthropogenic disturbances, beginning with the discovery of gold in California in 1848. Most relevant of these changes:

- ***vast influx of hydraulic mining sediment*** **-** It is estimated that from 1849 – 1909, the Yuba River received roughly 685 million cubic yards of sediment, more than the Upper Feather, Bear, and American rivers combined (Gilbert 1917). This influx caused such severe aggradation of the Yuba River that by 1868 the channel bed had risen 20 ft and was higher than the streets of Marysville (Ayres Associates 1997). Flooding in Marysville in 1875 prompted the prohibition of in-stream disposal of hydraulic mining sediments.
- ***shifting and confinement of the river's course*** **-** In the early 1900s, the California Debris Commission sanctioned the re-alignment of the lower Yuba River to the north of the historic alignment and the construction of large linear "training walls" consisting of steeply mounded tailings piles in the center and along both banks of the straightened river corridor. The training walls were piled to substantial heights above the 100-yr flood elevation and with dramatically varying top widths of up to 500 ft (AECOM 2015). The makeshift training walls were intended to laterally confine the river to allow for additional widespread dredging operations (gold mining) of the naturally occurring and hydraulic mining derived sediments deposited in the valley.
- ***river regulation and coarse sediment control*** **-** In 1906, Daguerre Point Dam was constructed as a partial sediment barrier and base-level control point. Englebright Dam was constructed in 1941, and was designed to keep upstream hydraulic mining debris out of the river (YCWA 2017). In 1971, New Bullards Bar was raised to control mining debris and generate power (Pasternack 2009). As a result, the influx of sediment and the major flood events have both been significantly altered, affecting the hydrologic regime and the movement of sediment in the system. Large woody debris passes over the dam, but is often greatly weathered or simplified from residence time in the reservoirs upstream and through passage over the dam (i.e., canopy and rootwad removed). This most likely reduces the ability of key pieces to lock in place within the channel.
- ***recent and ongoing aggregate mining*** **-** Widespread processing of the remaining Goldfield sediments continues today through surface and dredge mining for the production of aggregate and other construction materials. Uncertainties related to physical parcel boundaries and contentious mining interests/claims have influenced the development of an irregular moonscape characterized by long, linear, gravel/cobble mounds, steep ravines, isolated ponds, and loss of fine sediment required for riparian vegetation establishment. Dredger ponds support invasive predatory fish and other species that compete for resources with juveniles salmonids. The ponds can reconnect during high flows, allowing the movement of invasive species into the main river channel.

2.4.2 Regional Setting

The Action Area is located in a rural setting on the lower Yuba River. Features within and adjacent to the Action Area include the South Canal Diversion facility and associated canal system, Daguerre Point Dam, Hallwood-Cordua Diversion facility, USACE training levees, and the Yuba Goldfields. The Yuba Goldfields, which were formed by dredging activities associated with hydraulic mining and include significant quantities of irregular gravel and cobble mounds interspersed with ponds, are located to the south of the project site. Several unpaved access roads lead to the site via access though the Yuba Goldfields. The Hallwood-Cordua water diversion facility is located directly across from the South Canal Diversion, also upstream of Daguerre Point Dam. Areas to the north of the project site consist primarily of grazing lands. Daguerre Point Dam is located to the west of the project site. The lower Yuba River and USACE training levees are located to east of the project site.

2.4.3 Lower Yuba River Habitat

The south channel of the lower Yuba River, where work activities will occur, consists of run and riffle habitats. The middle and north channels within the Action Area are composed primarily of run habitat. Substrate in the 447-foot-long reach of the lower Yuba River where excavation will occur consists of gravel, cobble, and fines in varying percentages.

Riparian vegetation within the Action Area occurs adjacent to the south channel of the lower Yuba River. Species include sandbar and arroyo willows (*Salix interior* and *Salix lasiolapis*), white alders (*Alnus rhombifolia*), Fremont's cottonwoods (*Populus fremontii* subsp. *fremontii*), dense blackberry (*Rubus ursinus*), and wild grape (*Vitis californica*). Trees that are located directly adjacent to the channel provide partial shade cover and other services to the lower Yuba River, however, riparian vegetation only occurs sporadically.

2.4.4 Hydrology

The lower Yuba River flows 24 miles from Englebright Dam to its confluence with the Feather River, located southwest of Marysville, and conveys flows from the approximately 1,340-square-mile watershed (Sacramento River Watershed Program 2015). The YCWA South Canal Diversion canal is located just upstream from Daguerre Point Dam. Flows at this point in the river are regulated by upstream releases from Englebright Reservoir and New Bullards Bar Reservoir. These reservoir operations are typically controlled by flood control releases and releases to meet the Lower Yuba River Accord flow requirements. New Bullards Bar Reservoir is the principal storage facility of the Yuba River Development Project and is operated by YCWA for water supply and flood control purposes. Englebright Reservoir is located downstream of New Bullards Bar Reservoir. It traps mining debris, attenuates power peaking releases from New Colgate Powerhouse, and provides recreation opportunities. A portion of New Bullards Bar Reservoir storage capacity, 170,000 acre-feet, normally must be held empty from September 15 through May 31 for flood control operations.

2.4.5 Water Quality

The lower Yuba River provides water for several beneficial uses designated in the Central Valley Basin Plan, including: irrigation and stock watering, power supply, contact and non-contact recreation, warm and cold freshwater habitat, warm and cold migration, warm and cold spawning habitat, and wildlife habitat (Central Valley RWQCB 2016).

The Yuba River watershed contains a significant amount of sediments with mercury, as a result of historic hydraulic mining. Mercury is present in the bottoms of rivers and reservoirs and is transported by erosion processes and can be converted into methylmercury. As methylmercury accumulates in the food chain, it becomes concentrated, so that, in larger predatory fish (e.g., trout and bass), concentrations have the potential to exceed levels of concern for human consumption. The lower Yuba River is CWA Section 303(d)-listed for impairments associated with mercury (SWRCB 2011).

Water temperatures are an important water quality parameter for all life stage of anadromous fish species. Water temperatures in the lower Yuba River are influenced by the amounts and temperatures of water released from New Bullards Bar Reservoir to Englebright Reservoir, releases from the Narrows 1 and 2 Powerhouses, bypasses and spills from Englebright Dam, operations under the Yuba Accord Fisheries Agreement, and natural mechanisms associated with river geometry and climatic conditions (Yuba Accord Monitoring and Evaluation Program 2013). Temperatures in the lower Yuba River during summer and fall months are generally 1 to 5°F colder than they were under historical conditions. Although there are times of the year (in November through March) when water temperatures are slightly warmer than they were under historical conditions, suitable thermal regimes for all thermally sensitive species life-stages normally occur in the lower Yuba River (Yuba Accord Monitoring and Evaluation Program 2013).

2.4.6 CV Spring-run Chinook Salmon and CCV Steelhead and their Critical Habitat in the Action Area

All life stages of spring-run Chinook Salmon utilize the lower Yuba River, including adult immigration and holding, spawning, embryo incubation, fry and juvenile rearing, and juvenile and smolt emigration. The Action Area contains migration and, juvenile rearing habitats, and potential spawning habitat. Similar to adult spring-run Chinook Salmon, Central Valley steelhead also utilize the lower Yuba River for all freshwater life stages, including adult immigration and holding, spawning, embryo incubation, fry and juvenile rearing, and juvenile and smolt emigration. However, the habitat conditions in the Action Area limit steelhead's utilization of the river near the project site to migration and juvenile rearing, and potentially spawning.

2.4.7 Global Climate Change

By contrast to the conditions for other Central Valley floor rivers, climate change may not have as much of an impact on salmonids in the lower Yuba River downstream of Englebright Reservoir (YCWA 2010b). Presently, the lower Yuba River is one of the few Central Valley

tributaries that consistently has suitable water temperatures for salmonids throughout the year. Lower Yuba River water temperatures generally remain below 58°F year-round at the Smartsville Gage (downstream of Englebright Dam), and below 60°F year-round at Daguerre Point Dam (YCWA *et al.* 2007). At Marysville, water temperatures generally remain below 60°F from October through May, and below 65°F from June through September (YCWA *et al*. 2007). However, in dry years temperatures may become warmer than the optimum range for salmonids.

According to (YCWA 2010a), because of specific physical and hydrologic factors, the lower Yuba River is expected to continue to provide the most suitable water temperature conditions for anadromous salmonids of all Central Valley floor rivers, even if there are long-term climate changes. This is because New Bullards Bar Reservoir is a deep, steep-sloped reservoir with ample cold water pool reserves. Throughout the period of operations of New Bullards Bar Reservoir (1969 through present), which encompasses the most extreme critically dry year on record (1977), the cold water pool in New Bullards Bar Reservoir never was depleted. Since 1993, cold water pool availability in New Bullards Bar Reservoir has been sufficient to accommodate year-round utilization of the reservoir's lower level outlets to provide cold water to the lower Yuba River. Even if climate conditions change, New Bullards Bar Reservoir still will have a very substantial cold water pool each year that will continue to be available to provide sustained, relatively cold flows of water into the lower Yuba River during the late spring, summer and fall of each year (YCWA 2010a).

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.

Work will be performed during the summer low flow period (work window of August 6 to September 15 for initial construction and June 15 to September 15 for maintenance construction activities), which avoids the primary immigration and spawning windows of adult CCV steelhead and adult CV spring-run Chinook, and primary immigration window for CCV steelhead and CV spring-run Chinook smolts. Incubating salmonid eggs are unlikely to be present during the Proposed Action, as the construction window avoids the incubation period CCV steelhead and CV spring-run Chinook salmon eggs. The Action Area consists of riffles and runs, therefore likely does not serve as holding habitat for CCV steelhead or CV spring-run Chinook. Thus holding adults are not expected to be impacted by project construction. Juvenile CV spring-run Chinook and CCV steelhead may be present in the Action Area during work, and thus may be impacted by the Proposed Action.

The potential for the Proposed Action to adversely affect ESA-listed fish species and their critical habitats can be classified into two general categories: 1) temporary construction-related effects, which will occur only during active construction and 2) permanent effects, which result from longer-term existence of the conditions resulting from the Proposed Action. Potential construction-related effects include effects on fish migration and water quality, and direct injury

or mortality to fish. Potential permanent effects include effects to habitat as a result of placing LWD in the excavated portion of the south river channel and effects associated with the change in channel configuration.

2.5.1 Impacts to ESA-listed Fish Species

2.5.1.1 Water Quality: Increased Suspended Sediment and Turbidity during and after Construction

Elevated turbidity and suspended sediment levels will occur in the south channel of the Action Area downstream of the construction activities, while in-water work is occurring. These construction activities generally include construction of a temporary access road onto the gravel bar and in the lower Yuba River, excavation or river alluvium, placement of cobble within the excavated channel, placement of LWD, maintenance of the excavated channel, if necessary, restoration of temporary components and removal of temporary fill.

Construction mobilization, including setting up previously used staging areas, will occur above the OHWM in upland areas. Additionally, constructing the access road to the upstream gravel bar will be conducted above the OHWM and away from the river channel. To ensure that runoff and sedimentation do not enter the lower Yuba River, a turbidity curtain will be placed at the edge of the construction zone. Construction of the temporary access road onto the upstream gravel bar and in the lower Yuba River will occur immediately following the construction of the temporary access road to the upstream gravel bar and will be a continuation of the same road, including a connecting ramp from the upland area adjacent to the river to the upstream gravel bar. This component of the action will occur below the OHWM, on the river bank directly adjacent to the river, and in the river channel. The temporary access road on the gravel bar (which will be in a dry area) will be constructed using dredge tailings stockpiled during the 2017 emergency repairs. The portion of the temporary construction road in the lower Yuba River (which will be in a wet area) will be constructed using locally imported cobble material with a gravel dressing.

The substrate in the Action Area is composed mostly of gravel, cobbles, and fine materials. Excavation of river alluvium will require use of a long-arm excavator operating from the temporary access road to remove the materials from the river channel, which will cause sediment resuspension and increase downstream turbidity within the south channel of the Action Area. The area of disturbance to the streambed will be approximately 0.68 acre. Approximately 1,390 CY of river alluvium will be removed from the channel, but 1,400 CY of 3 -12 inch cobbles of the excavated material will be placed back into the channel to serve as channel lining to prevent future erosion. At the completion of the Proposed Action, the temporary excavated channel will be restored to pre-existing conditions using suitable material and an excavator. After all repair activities are completed, all temporary fill that was imported to the project site will be removed and taken to the off-channel storage site located in the uplands approximately 0.3 mile south of Daguerre Point Dam. If necessary, maintenance activities may occur in 2019 if the excavated channel plugs up with sediment or other debris. Removal of sediment or debris during maintenance actions, if necessary, will be completed using an excavator.

The degree of sediment resuspension associated with any of the components of the Proposed Action is determined by multiple factors including sediment properties, water depth, velocity, impediments and operational factors. Due to the location of the temporary access road construction, the vast majority of the suspended sediment and turbidity generated from in-river construction will flow into the south channel and then into the SCD facility and ultimately into the YCWA canal system. Thus, most of the construction generated suspended sediment and turbidity will not occur in the middle or north channels, and much of this turbidity will not exit the Action Area, but rather will be transported with diversions through the SCD. Turbidity plumes are expected to affect a portion of the channel width and extend up to 1,013 feet downstream of the site.

High concentrations of suspended sediment can have both direct and indirect effects on salmonids. The severity of these effects depends on the sediment concentration, duration of exposure, and sensitivity of the affected life stage. Based on the types and duration of proposed in-water construction methods, short-term increases in turbidity and suspended sediment may disrupt feeding activities or result in avoidance or displacement of fish from preferred habitat. Juvenile salmonids have been observed to avoid streams that are chronically turbid (Lloyd 1987) or move laterally or downstream to avoid turbidity plumes (Sigler *et al.*). Sigler et al. (1984) found that prolonged exposure to turbidities between 25 and 50 NTUs resulted in reduced growth and increased emigration rates of juvenile coho salmon and steelhead compared to controls. These findings are generally attributed to reductions in the ability of salmon to see and capture prey in turbid water (Waters 1995). Chronic exposure to high turbidity and suspended sediment may also affect growth and survival by impairing respiratory function, reducing tolerance to disease and contaminants, and causing physiological stress (Waters 1995). Berg and Northcote (1985) observed changes in social and foraging behavior and increased gill flaring (an indicator of stress) in juvenile coho salmon at moderate turbidity (30-60 NTUs). In this study, behavior returned to normal quickly after turbidity was reduced to lower levels (0-20 NTU).

Any increase in turbidity associated with instream work is likely to be brief and not extend past Daguerre Point Dam. Temporary spikes in suspended sediment may result in behavioral avoidance of the site by fish; several studies have documented active avoidance of turbid areas by juvenile and adult salmonids (Bisson and Bilby 1982, Lloyd 1987, Servizi and Martens 1992, Sigler et al. 1984). Individual fish that encounter increased turbidity or sediment concentrations will likely move away from affected areas into suitable surrounding habitat.

Water quality, including measurements of turbidity will be performed on a regular basis during construction to track the response of water quality to construction activities. An onsite biologist will report these measurements to the project manager, who will be aware of Federal and state water quality requirements. These plumes will occur intermittently during daylight hours, resulting in daily periods (at least 14 hours) in which water quality will return to background levels. Incorporation of AMM 4 (Turbidity Control) and AMM 5 (Erosion and Sedimentation Control) will be used to minimize suspended sediment levels and turbidity in the south channel during the construction period. Nonetheless, increased suspended sediment and turbidity will occur in the south channel during in-river construction (e.g., excavation of alluvium, placement of LWD, and removal of temporary fill). The greatest increase in water column suspended sediment and turbidity levels will be confined to the south channel where AMM 4 (Turbidity

Control) will be implemented. The Proposed Action will be conducted in accordance with the requirements of Clean Water Act Section 401 Water Quality Certification. Such activities will minimize water quality impacts.

Sedimentation is known to have lethal and sublethal effects to incubating salmonids eggs by decreasing dissolved oxygen transport between spawning gravel. Sediment also blocks micropores on the surface of incubating eggs, inhibiting oxygen transport and creates an additional oxygen demand through the chemical and biological oxidation of organic material (Kemp *et al*. 2011, Greig *et al*. 2005, Suttle *et al*. 2004). However, due to the location and timing of construction, CV spring-run Chinook, and CCV steelhead eggs are not expected to be present in the Action Area, and thus adverse impacts to incubating eggs are not expected to occur.

The timing of the project (August 6 – September 15 for construction and June 15 – September 15 for maintenance) avoids the main immigration windows of adult CCV steelhead CV spring-run Chinook salmon, and the Action Area lacks holding habitat, thus adults of these species are not expected to be present during activities. If an adult steelhead or spring-run Chinook salmon does pass through the area during construction, it is expect that it will swim away quickly in response. Therefore, impacts to adults of these species is considered improbable. Incubating salmonid eggs and immigrating smolts are unlikely to be present during the Proposed Action, as the construction window avoids the incubation period and main smolt immigration windows for CCV steelhead and CV spring-run Chinook salmon. Thus potential for impacts to this life stage of these species is also considered improbable. Juvenile CCV steelhead and CV spring-run Chinook may be present during instream construction activities, and thus subject to the above effects. However, with the above avoidance and minimization measures in place, the effects of increased turbidity will be minor and are unlikely to result in injury or death.

2.5.1.2 Water Quality: Contaminants Entering the River from Construction Equipment

Because all construction activities associated with the Proposed Action will involve the use of heavy equipment, accidental chemical spills could occur. Since these construction activities will require heavy equipment to operate near the edge of and in the river channel, there is potential for inadvertent spills of fuels and other hazardous materials to enter the lower Yuba River. Accidental spills and leakage from construction equipment may include fuel, lubricants, hydraulic fluids and coolants. An accidental spill or inadvertent discharge of contaminants into the lower Yuba River associated with project activities could harm spring-run Chinook salmon and steelhead. The potential magnitudes of biological effects to ESA-listed fishes resulting from accidental or unintentional contaminant spills would depend on several factors, including the proximity to the water body, the type, amount, concentration, and solubility of the contaminant, and the timing and duration of the discharge. Contaminants entering the lower Yuba River in sufficient amounts could affect survival and growth rates of ESA-listed fish using the waterbody and other aquatic organisms including prey sources. Petroleum products can cause oily films to form on the water surface that can reduce DO levels available to aquatic organisms. The severity of the effects would depend on species and life stage sensitivity, duration of exposure, condition or health of individuals (including nutritional status), and physical or chemical properties of the water (including temperature and DO). Potential effects could range from no effect to mortality.

The Proposed Action will also be conducted in accordance with the requirements of Clean Water Act Section 401 Water Quality Certification. Further, AMM 3 (construction best management practices) will be implemented to prevent and reduce any potential effects resulting from the unlikely event of a hazardous spill. Avoidance and minimization measures (i.e., AMM 3 - Construction Best Management Practices and Monitoring) are included in the project description to avoid and minimize the potential for the discharge of contaminants into the lower Yuba River to occur. These measures, such as locating staging, fueling, and storage areas away from the lower Yuba River, having containment plans and equipment on site, and ensuring that construction personnel are trained to respond to spills rapidly, are intended to reduce the probability for the release of toxic or hazardous materials to the lower Yuba River, establish measures to contain any accidental spills quickly, and constrain in-river activities to the minimum necessary. With these avoidance and minimization measures in place, accidental spills of equipment-related contaminants into the lower Yuba River are very unlikely to occur. In the highly unlikely event of a spill, containment and recovery procedures will be utilized to minimize the volume of contaminant that could enter the lower Yuba River, and length of time the contaminant is in the river. Any incidental "wash-off" of construction equipment-related contaminants that could occur from operating the equipment in the wet would be sufficiently low in volume that concentrations of such contaminants in the river would be well below levels that would impact affect aquatic resources. Due to the above BMPs and the timing of the project, which precludes the occurrence of most life stages, the potential for impacts to spring-run Chinook salmon or steelhead from contaminants entering the river is considered improbable.

2.5.1.3 Underwater Noise during Construction

Because in-river construction activities associated with the Proposed Action will involve the use of heavy equipment, construction activities could result in temporary periods of elevated underwater noise levels in the lower Yuba River. These construction activities include construction of a temporary access road onto the gravel bar and in the lower Yuba River, excavation of river alluvium, import and placement of LWD, any necessary maintenance actions, removal of temporary fill, and restoration actions once the Proposed Action is completed.

Noise resulting from operating equipment in and adjacent to the river channel could potentially cause disturbance, injury, or mortality to ESA-listed fishes if underwater noise levels were to exceed effect thresholds while fish were present. The type and severity of effects will depend on several factors, including the intensity and characteristics of the sound, the distance of the fish from the source, and the frequency and duration of the noise-generating activities. Construction will not occur at night (AMM 1 – Timing of In-water Work), leaving a daily periods of approximately 14 hours or more with no noise generated from construction activity. Nonetheless, ESA-listed species will be exposed to noise-generating activities during much of the remaining period of the Proposed Action.

Generally, placement of fill for the temporary access road will be conducted by off-road haul trucks and a D8 bulldozer. A long-arm excavator will be used to excavate river alluvium, place anchor rock for LWD, complete any necessary maintenance actions, restore temporary areas to pre-existing conditions, and remove temporary fill, which will produce sounds emanating from the equipment and from the excavator making direct contact with the sediment. Underwater

sound pressures arising from sediment removal will have the potential to adversely affect ESA-listed fishes. The potential effects associated with elevated noise levels may include lethality or injury (e.g., hearing damage, reduced inner ear equilibrium capacity) to fish arising from excessive noise levels. Potential effects also include "noise barriers" created by elevated underwater noise levels, which might prevent or delay adult and juvenile fish from passing the construction site. Sufficiently long delays of immigrating adult spring-run Chinook salmon could increase the risk for thermally induced pre-spawning egg loss.

The amount of underwater noise that will be generated is likely attenuated substantially by the presence of differing depths, velocities, and non-uniform substrates in the Action Area. Any increase in noise levels associated with these activities will be temporary and localized and is not expected to reach levels that would cause adverse effects. Specifically, noise levels will not reach levels that would cause physical injury or lethality, and any behavioral startle or avoidance responses that may occur will be brief. Any effects from underwater noise will be localized, of short duration, and the avoidance behavior will not rise to the level of disturbance and there is no realistic potential that these effects will lead to harm or harassment of individual fish.

The timing of the project (August 6 – September 15 for construction and June 15 – September 15 for maintenance) avoids the main immigration windows of adult CCV steelhead CV spring-run Chinook salmon, and the Action Area lacks holding habitat, thus adults of these species are not expected to be present during activities. If an adult steelhead or spring-run Chinook salmon does pass through the area during construction, it is expect that it will swim away quickly in response. Therefore, adverse impacts to adults of these species are considered improbable. Incubating salmonid eggs and immigrating smolts are unlikely to be present during the Proposed Action, as the construction window avoids the incubation period and main smolt immigration windows for CCV steelhead and CV spring-run Chinook salmon. Thus potential for impacts to this life stage of these species is also considered improbable. Juvenile CCV steelhead and CV spring-run Chinook and sDPS may be present during instream construction activities, and thus subject to the above effects. However, as described above, the localized and short-term nature of the increases in noise mean that impacts to juvenile salmonids is expected to be minimal and not likely to result in harm, injury, or death of any fish.

2.5.1.4 Direct Injury and Mortality from Equipment Operation

Spring-run Chinook salmon and steelhead could be injured or killed by direct contact with construction equipment. Construction activities could result in direct injury and mortality to spring-run Chinook salmon and steelhead from construction of a temporary access road onto the gravel bar and in the lower Yuba River, excavation or river alluvium, import and placement of LWD, any potential maintenance that is necessary, restoration of temporary areas, and removal of temporary fill.

The timing of the project (August 6 – September 15 for construction and June 15 – September 15 for maintenance) avoids the main immigration windows of adult CCV steelhead CV spring-run Chinook salmon, and the Action Area lacks holding habitat, thus adults of these species are not expected to be present during activities. If an adult steelhead or spring-run Chinook salmon does pass through the area during construction, it is expect that it will swim away quickly in response.

Incubating salmonid eggs and immigrating smolts are unlikely to be present during the Proposed Action, as the construction window avoids the incubation period and main smolt immigration windows for CCV steelhead and CV spring-run Chinook salmon. Thus potential for impacts to this life stage of these species is also considered improbable. Juvenile CCV steelhead and CV spring-run Chinook and sDPS may be present during instream construction activities, and thus subject to the above effects.

Due to the underwater noise, turbidity, and flow pattern disruption (i.e., disruption of laminar flow vectors immediately adjacent to the equipment itself), it is expected that the most spring-run Chinook salmon and steelhead juveniles would leave the Action Area at the start of construction. Construction equipment will be moved into the south channel and allowed to idle for five minutes at the initiation of daily in-water construction activities in order to allow fish to move out of the area. Although it is anticipated most juveniles will leave the Action Area at the start of construction, there is a possibility that a small minority of juveniles will not escape in time, and then be crushed or otherwise injured, and potentially killed by construction equipment and personnel. NMFS estimates no more than 9 juvenile steelhead will be harmed and 3 will be killed by construction equipment and personnel each year of the project (construction in 2018 and maintenance in 2019). NMFS also estimates no more than 5 juvenile spring-run Chinook will be harmed and 2 will be killed by construction equipment and personnel each year of the project (construction in 2018 and maintenance in 2019).

Juveniles that migrate away in response to instream construction activities may endure short term stress from being forced to migrate away from their rearing area and needing to locate a new rearing area downstream. Fish may endure some short term stress from crowding and competition with resident fish for food and habitat. Fish may be subject to increased predation risk while they are locating a new rearing area. However, displaced fish will likely locate to areas upstream or downstream that have suitable habitat and low competition. It is not expected that the temporary displacement of fish or the competition they endure will affect the survival chances of individual fish or cascade through the population based on the size of the area that will likely be affected and the small number of impacted CCV steelhead and CV spring-run Chinook salmon.

Although construction avoids the main immigration periods of adult spring-run Chinook and steelhead, it does overlap with the beginning of adult steelhead's return to freshwater. At the time of construction, steelhead entering freshwater would most likely not have reached as far upstream as the project site, and instead would likely still be lower in the system. It is expected that any adults would preferentially choose to migrate through the north channel rather than the south channel, as the north channel conveys 90% of the flow. There nonetheless is a very small chance adults will have reached the construction site at the time of construction and will pass through the south channel. The construction crew will be installing a turbidity curtain across the south channel to prevent excess turbidity impacts, which could cause a temporary delay in passage. However, the curtain will be placed 6 inches from the stream bed to allow fish passage to continue, just in case adult steelhead are present. The curtain will also be removed each night to further ensure fish passage to adult steelhead is impeded as little as possible.

2.5.1.5 Long-term Impacts Modified Channel Flows

Excavation of the south channel to alleviate the constriction that was the result of the 2017 high-flow events will allow for additional water to flow into the south channel. Regardless of the total flow in the lower Yuba River, implementation of the Proposed Action will result in an increased proportion of the total flow entering the south channel and a corresponding proportional decrease in the total flow entering the north and middle channels. The increased flow in the south channel is intended to enhance flow to the SCD and improve fish passage in that channel for spring-run Chinook salmon and steelhead. Although flows will be reduced in the north and middle channels, the majority of water will continue to flow through the north channel of the Yuba River after implementation of the Proposed Action.

The primary effect of the modeled inflow changes is that sufficient flow will be conveyed through the south channel to enable adult spring-run Chinook salmon and steelhead to immigrate through the south channel to upstream spawning habitats under the Proposed Action, which based on a range of modeled inflows, is not possible under current conditions. NMFS has developed transport velocity criteria between 1.5 and 4.0 feet per second (ft/s) that must be met: 1) between a fishway entrance and the first fishway weir and 2) in fishway channels (NMFS 2011). Although these criteria were developed as fishway design criteria, they are useful as guidelines for identifying potential velocity barriers in engineered river channels. Additionally, NMFS (2011) identified a range of velocities as suitable for adult Chinook salmon and steelhead passage when these velocities occur in culverts for specific distances. Because the excavated channel upon completion of the Proposed Action will not be as confined as a culvert and will have greater hydraulic roughness, these NMFS culvert criteria are considered protective of fish passage in the Action Area. Modeled approximate peak velocities under the Proposed Action range from almost 4 feet per second (ft/s) to just above 5 ft/s. Additionally, although velocities above 4 ft/s will occur under the Proposed Action, these modeled velocities do not include the changes in velocities that will result from implementation of the LWD component of the Proposed Action, since velocity refugia in the form of LWD cannot be accurately modeled. Therefore, it is assumed that with the addition of LWD, actual velocities in the excavated channel will be considerably less than the modeled velocities. Specifically, passage opportunities for individual adult spring-run Chinook salmon and steelhead migrating through the Action Area will be improved under the Proposed Action because velocity criteria will be met because LWD will be installed in the excavated channel pursuant to NMFS and CDFW requests.

Corresponding flow reductions also will occur in the north and middle channels, but are not expected to reduce passage opportunities for adult spring-run Chinook salmon and steelhead migrating through those channels to spawning areas. The Proposed Action will result in decreases in flows in the middle and north channels over the modeled range of inflows of approximately 55–140 cfs and 190–300 cfs, respectively. This will result in middle and north channel flows of approximately 31–285 cfs and 825–1,536 cfs, respectively. These flow reductions will be small, relative to overall flows in the Action Area, will be temporary, and will not result in reduction of passage opportunities for immigrating adults or emigrating juveniles at any of the modeled inflows. Therefore, these temporary reductions in the middle and north channel flows will have only minor effects to adult spring-run Chinook salmon and steelhead

migrating through the north and middle channels in the Action Area, and these reductions are unlikely to result in harm, injury or death.

Additionally, the increased flow in the south channel will add a migratory pathway for outmigrating juveniles, while the corresponding reductions in flows in the north and middle channels are not expected to reduce migratory pathways for outmigrating juveniles. Although the number of juveniles that will pass the SCD under the Proposed Action is unknown, excavation in the south channel will result in this channel functioning as a juvenile migration corridor with greater flows than the flows in the diversion channel at all modeled inflows. Juvenile outmigrants are expected to remain in the south channel rather than enter the diversion channel. Nonetheless, some additional outmigrating juveniles could enter the diversion channel as a result of the Proposed Action. However, the proposed action is not expected to increase the exposure of fish to the rock gabion fish exclusion structure beyond the level currently occurring under baseline conditions. Since there will be more flow in the south channel than the diversion channel, the potential for a small amount of additional juvenile fish entering the diversion channel is expected to be minor, and not result in an increase in harm, injury, or death over baseline conditions.

2.5.1.6 Long-term Impacts of Vegetation Removal

Riparian habitat, especially the SRA component, is important for rearing and out-migrating juvenile salmon because it provides overhead and instream cover from predation and enhances food production. Terrestrial insects and IWM that fall from riparian plants into the river enhance the aquatic food webs and provide high-value feeding areas for juvenile salmonids. Once in the river channel, the stems, trunks, and branches become very important structural habitat components for aquatic life. Many of the aquatic invertebrates that are primary food sources for juvenile salmon and steelhead live on woody debris. In some cases, the reproductive cycles of macroinvertebrates are tied to IWM, as their eggs are laid and develop inside fallen logs and are eventually eaten by fishes.

Riparian shade can be critical in preventing diurnal thermal maxima from reaching dangerous levels, thereby extending the usable season for small streams (Maslin *et al.* 1997). Trees and shrubs growing along river banks providing microclimates of cooler water temperatures during the hot summer months where many fishes will congregate to feed and seek cover. In addition, the roots, branches and other submerged plant materials provide cover for young fishes, as well as nutrients and sources of invertebrates.

Construction of material stockpiles and staging areas occurred during the emergency repair work completed in 2017. These same areas, which are located in upland areas away from the river and were previously cleared of vegetation, will also be used for the Proposed Action. Clearing the area to allow construction of a temporary access road to the upstream gravel bar will require clearing and grubbing of approximately 185 linear feet of riparian vegetation. Riparian vegetation to be removed includes sandbar and arroyo willows (*Salix interior* and *Salix lasiolapis*), white alders (*Alnus rhombifolia*), Fremont's cottonwoods (*Populus fremontii* subsp. *fremontii*), dense blackberry (*Rubus ursinus*), and wild grape (*Vitis californica*). All vegetation to be removed is separated from the river's edge by approximately 30 to 50 feet of riparian

vegetation, and is located above the OHWM. Therefore, the riparian vegetation to be removed provides minimal, if any, habitat value for ESA-listed fish species. All trees removed during the clearing of vegetation will be replanted 3:1 ratio. Within two years after replanting, the area is expected to be completely revegetated. Due to how far the removed vegetation is from the river, and the fact that vegetation will be replanted, impacts to all life stages of spring-run Chinook salmon and steelhead are expected to be minimal and not likely to result in harm, injury, or death of any fish.

2.5.1.7 Long-term Impacts of Placement of Excavated Alluvium on Upstream Gravel Bar

Placement of river alluvium on the adjacent gravel bar ensures that the material will not lose its function in the lower Yuba River. Specifically, the excavated alluvium is very similar to alluvium on the upstream gravel bar. Therefore, placement of excavated alluvium on the gravel bar will not alter the existing functions of the gravel bar when it is inundated, which currently occurs annually when total river flows are approximately 3,500 cfs (at the Smartsville gage). Because placement of river alluvium on the upstream gravel bar will occur in dry areas, no additional construction-related effects associated with placement of alluvium on the excavated gravel bar will occur. Therefore, placement of alluvium on the upstream gravel bar will only result in potential effects on spring-run Chinook salmon and steelhead when the gravel bar is inundated, which occurs when total river flows are above approximately 3,500 cfs (at Smarstville). Due to the relatively small amount of alluvium that will be placed on the gravel bar, placement of excavated alluvium would not alter the inundation frequency or hydraulic characteristics of the gravel bar. Additionally, because the excavated and placed alluvium is very similar in composition to the alluvium in the gravel bar, no changes in function or habitat value will occur. Therefore, impacts to all life stages of spring-run Chinook salmon and steelhead due to the placement of alluvium are considered improbable.

2.5.1.8 Long-term Impacts of Placement of Large Woody Debris

Upon completion of excavation activities in the south channel, LWD will be placed into the excavated channel to reduce water velocities and aid fish migrating through the south channel. LWD will be spaced approximately 125 feet apart and secured in place by partial burial and bolstering with imported large rocks. Three units of LWD will be placed into the excavated channel, and will cover an area of approximately 0.02 acre. LWD will provide structural coverage and velocity refuge for juvenile salmonids, as well as increase instream habitat diversity and complexity within the site.

Velocity refuges created by LWD placed in the south channel will provide hydraulic breaks for adult spring-run Chinook salmon immigrating through the excavated portion of the south river channel during the summer and fall period, where flow velocity will be high (e.g., 2–5 fps). Although the channel configuration in the Action Area is expected to change over time, as long as it remains similar to the project design, the creation of permanent velocity refugia from the placement of LWD is expected to benefit spring-run Chinook salmon and steelhead immigration. Should the LWD become displaced downstream by high winter flow events, it will either retain its hydraulic refugia benefits at another location, or will provide cover for juvenile rearing spring-run Chinook salmon and steelhead. Therefore, the additional of LWD to the lower Yuba

River channel will have beneficial effects to both adult and juvenile spring-run Chinook salmon and steelhead.

2.5.1.9 Long-term Impacts of Channel Modification

Prior to the high-flow events in January and February 2017, the south channel was the primary river flow channel upstream of Daguerre Point Dam, because the north channel was partially blocked by a gravel bar constriction at its upstream end. During the early 2017 high flow events, the north channel constriction was scoured away, allowing more water to flow through the north channel. In addition, the entrance to the south channel became constricted due to extensive deposition of river alluvium. This resulted in a redistribution of flows with most of the flow in the Action Area flowing through the north channel. Spring 2018 high flows events further redistributed some river flows to the middle channel. Excavating river alluvium from the south channel will redistribute the flow among these channels. Although flows will increase in the south channel, relative to current conditions, the majority of water will continue to flow through the north channel. The modification will partially restore the hydraulic flow capacity of the south channel so that flows are more similar to that which existed before the winter 2017 high flows. Channel modifications resulting from excavation of the south channel will be small in scale, relative to the migration and rearing areas of the lower Yuba River generally and Action Area specifically.

Because the Yuba River is a dynamic river, the conditions in the north, middle, and south channels are likely to continue change each year. The changes to the channel by the project are within the range of natural changes that occur during high flow events. For example, prior to the 2017 high-flow events, there was no riffle at the entrance of the south channel. Following the 2017 high-flow events, a large riffle formed at the top of the south channel. During the spring 2018 high flow events, this riffle was substantially altered. As much as three feet of material was removed from the upper riffle area and deposited in the run, downstream of the riffle. The upper riffle was converted to run habitat. The remaining riffle habitat is substantially smaller than it was prior to the high flows that occurred during spring 2018. This excavation will generally result in alterations of the existing habitat types and in conversion of riffle and run habitat into a single deep run. However, the excavation will also ameliorate the large gouge left in the streambed by the contractor for the South Yuba Water District (see Section 1.1 Background), returning the streambed to a more natural state more suitable for use by salmonids.

The removal of riffle habitat and conversion of the run and riffle sequence to single run will likely not alter use of the Action Area by spawning salmonids. Although steelhead were observed spawning in the riffle (RM 12.2) prior to the high flows in spring of 2018, the majority of steelhead spawning occurs in the Parks Bar (RM 13.9–18.6)) and Timbuctoo Bend (RM 18.6–22.3) geomorphic reaches of the lower Yuba River (YCWA 2017). Because high flows eroded as much as three feet of substrate from the riffle in the Action Area, it is assumed that redds and incubating embryos were scoured away as high flows eroded the substrate. Spawning habitat in the action area is likely of poor quality because the high flows that occurred during 2018 removed several feet of substrate, resulting in subsurface substrates with high proportions of fine sediments that limit embryo survival. Improving fish passage through the south channel is expect to provide spawning adults with better access to higher quality spawning habitat. Due to the low

quality spawning habitat in the area, relatively minor changes (and generally positive changes) to the channel, and the improvement to immigration through the south channel, impacts to spawning spring-run Chinook and steelhead are considered minimal and not likely to result in harm, injury, or death of any fish.

Migration habitat for adult spring-run Chinook salmon and steelhead in the south channel will be improved relative to current conditions. Because both the north and south fish ladders provide adequate access to the river upstream of Daguerre Point Dam, restoring and increasing physical connectivity via the south channel will improve adult salmonid migration pathways in the lower Yuba River, and likely will result in greater passage opportunity and use of the south channel. Therefore, the project is considered to be beneficial individual migrating adults and juveniles. The alteration of the channel configuration is not expected to cause any impacts to rearing juvenile steelhead or spring-run Chinook salmon, as it is not expected to alter the configuration in any way that will interfere with juvenile rearing or reduce the quality of the habitat for rearing juveniles.

2.5.2 Critical Habitat

2.5.2.1 Temporary Adverse Impacts from Construction

The project is expected to have some temporary adverse impacts to during construction and maintenance to freshwater rearing for juvenile CV spring-run Chinook and CCV steelhead. AMM 4 (Turbidity Control) and AMM 5 (Erosion and Sedimentation Control) are expected to reduce turbidity to the greatest extend feasible, however the increases in turbidity and suspended sediment anticipated to occur from in-water construction activities are still expected to temporarily degrade the quality of the habitat for juveniles that may be rearing in the Action Area. Similarly, the presence of construction equipment and personnel is also expected to temporarily impact the quality of habitat in the Action Area for the PBFs of freshwater rearing.

Vegetation removal will be set back from the edge of the river by approximately 50 feet, and will occur above the OHWM. Due to the distance from the water, and the fact that the vegetation will be replaced at a 3:1 ratio, impacts from vegetation removal to the PBFs of juvenile rearing are considered minimal.

Contaminants at sufficiently high levels could adversely affect one or more of the PBFs of the designated critical habitats of spring-run Chinook salmon and steelhead that occur in the Action Area. However, because the potential for a contaminant spill into the river to occur with AMM 3 being implemented is very low, contaminant spills are extremely unlikely to occur. Any incidental “wash-off” of construction equipment-related contaminants that could occur from operating the equipment in the wet would be sufficiently low in volume that concentrations in the river would be well below effect levels to aquatic resources and their habitat features. Therefore, impacts to the PBFs of critical habitat for spring-run Chinook salmon and steelhead due to contaminants is considered improbable.

2.5.2.2 Permanent impacts to Channel Flows and Configuration

The Proposed Action will not change the total lower Yuba River flow entering or exiting the Action Area, and will only alter the flow splits among the south, middle, and north channels. Flow rates will be increased in the south channel under the Proposed Action, which will provide a beneficial effect to spring-run Chinook salmon and steelhead, facilitating their reaching their freshwater spawning sites in the lower Yuba River, which are located upstream of the Action Area. The proposed action is therefore expected to improve the PBFs of freshwater migration corridors. The flow reductions to the middle and north channels are small enough such that impacts to the PBF of freshwater migration corridors in these channels is considered very minimal.

Channel modification will alter the configuration of existing critical habitat but will not alter the PBFs of freshwater migration corridors or freshwater rearing habitat, because the resulting reconfigured channel will continue to provide migration and rearing habitat, which actually will be enhanced due to the installation of large wood and removal of the large gouge in the streambed. Thus, with the improvements to migratory pathways in the south channel that will result from implementation of the Proposed Action, improved accessibility will occur to upstream areas of critical habitat, as well as to high quality spawning areas for adult spring-run Chinook salmon and steelhead.

Although the Proposed Action will remove riffle habitat and convert it to run habitat, the freshwater spawning PBF of critical habitat will not be adversely affected because the riffle where spawning was observed in 2018 was scoured and reconfigured by high flows in spring 2018. Additionally, recent observations of a high percentage of fine sediments in subsurface substrate suggest that spawning would not be successful in the Action Area. Therefore, impacts to the PBF of freshwater spawning habitat are considered insignificant.

The relatively small amount of very similar alluvium that may be placed on the existing gravel bar will be of sufficiently low magnitude to not cause any adverse effects on spring-run Chinook salmon or steelhead critical habitat within the Action Area. For this reason, there will be no discernible impacts to the PBFs of critical habitat, and thus the potential for effects is considered improbable.

Installation of LWD will reintroduce areas of lower velocity which will contribute to improved PBFs of freshwater migration corridors and freshwater rearing habitat of spring-run Chinook salmon and steelhead. Restoring habitat diversity and hydraulic complexity will support other ecological functions that are characteristic of natural rivers and floodplains. Thus, installation of LWD will benefit the PBFs of freshwater migration corridors and freshwater rearing for steelhead and spring-run Chinook salmon in the Action Area.

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 environmental baseline (Section 2.4).

Few future non-Federal actions that may affect the Action Area are expected to occur. Non-Federal actions that may affect the Action Area include angling and State angling regulation changes, agricultural practices, private water contracts, habitat restoration or maintenance, water withdrawals and diversions, adjacent mining activities, and increased population growth resulting in urbanization and development of floodplain habitats.

California angling regulations have moved toward restrictions on recreational sport fishing to protect listed fish species but incidental hooking of Chinook salmon, hook and release mortality of steelhead, and disturbance of redds by wading anglers may continue to cause a threat. Habitat restoration and maintenance projects may have short-term negative effects associated with in-stream construction activities, but these effects are temporary and localized with listed species and habitats expected to benefit long term. Prolonged periods of elevated water turbidity levels may result from agricultural practices, adjacent mining activities, and increased urbanization and/or development of riparian habitat, and could adversely affect the ability of juvenile salmonids to feed effectively, resulting in reduced growth and survival. Turbidity may cause injury or mortality to juvenile CV spring run Chinook salmon and CCV steelhead rearing in the vicinity and downstream of the project area. High turbidity levels can cause fish mortality, reduce feeding efficiency, and decrease food availability (Berg and Northcote 1985). Farming and ranching activities within or adjacent to the Action Area may have negative effects on water quality due to runoff containing agricultural chemicals. 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. Future urban and/or rural residential development may adversely affect water quality, riparian function, and aquatic productivity. Most of these actions would require Federal permits, and would undergo individual or programmatic Section 7 consultation. No known specific and reasonably certain future state or private activities are expected to occur within the Action Area, other than those ongoing activities already discussed in the existing conditions.

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.

CCV steelhead and CV spring-run Chinook have experienced significant declines in abundance and available habitat in the California Central Valley relative to historical conditions. The status of the species and critical habitat and environmental baseline sections (2.2 and 2.4) detail the current range-wide status of these ESUs and also the current baseline conditions found in the Yuba River, where the Proposed Action is to occur. Sections 2.1.3 and 2.4.7 discusses the vulnerability of listed species and critical habitat to climate change projections in the California Central Valley and specifically in the Yuba. In light of the predicted impacts of global warming, it has been hypothesized that summer temperatures and flow levels will become unsuitable for salmonid survival in many parts of the Central Valley. However, because of specific physical and hydrologic factors (discussed in section 2.4.6) the lower Yuba River is expected to continue to provide the most suitable water temperature conditions for anadromous salmonids of all Central Valley floor rivers, even if there are long-term climate changes (YCWA 2010a).

Cumulative effects that may affect the Action Area include angling and State angling regulation changes, agricultural practices, private water contracts, habitat restoration or maintenance, water withdrawals and diversions, adjacent mining activities, and increased population growth resulting in urbanization and development of floodplain habitats.

2.7.1 Effects of the Proposed Action to Listed Species

The Proposed Action has the potential to affect various life stages of CCV steelhead and CV spring-run Chinook. However, the only life stages that are expected to be present in the Action Area during initial construction and construction for maintenance are juvenile CCV steelhead, juvenile CV spring-run Chinook, and adult CCV steelhead. Juveniles of these species may be injured or killed during construction by construction equipment or personnel. Construction may result and excessive sediment and turbidity pulse events, but BMPs in place are expected to minimize the impact of turbidity such that no adverse impacts will occur. Similarly, impacts due to contamination/pollution are considered improbable due to the applicant's BMPs. The project is expected to cause a temporary decrease in riparian habitat, but the impacts from this vegetation removal are considered minimal and not likely to result in harm, injury, or death of any fish. since 1.) the removed vegetation is located sufficiently far from the river 2.) vegetation will be replanted at a 3:1 ratio. Changes due to the placement of excavated alluvium are expected to be so minor that they are undetectable and improbable. Long-term impacts to spawning adult steelhead and spring-run Chinook are expected to be minor and not result in harm or death, due to the fact that the area does not provide good quality spawning habitat, and the changes to the channel configuration will allow better passage to higher quality habitat upstream. A very small number of adult steelhead may be harmed by temporary passage delays during the daylight hours. The project is expected to benefit immigrating juveniles and adult spring-run Chinook and steelhead by improving passage through the south channel, and rearing juveniles of both species are expected to benefit from the installation of large wood.

2.7.2 Effects of the Proposed Action to Critical Habitat

The freshwater rearing PBF also has the potential to be adversely effected in the course of the proposed construction operations due to temporary increases in turbidity, noise, and disturbance associated with construction personnel and equipment. However, the beneficial effects to critical habitat PBFs far outweigh the adverse effects. The results of the Proposed Action will ultimately enhance the PBFs of freshwater rearing by installing LWD and removing large gouge in the streambed, restoring the channel to a more natural configuration. By increasing passage through the south channel, the project will benefit the PBF of freshwater migration for spring-run Chinook and steelhead. The project is expect to have a minimal impact on the PBF of spawning for spring-run Chinook and steelhead, as the area does not serve as high quality spawning habitat due to amount of fine material in the sediment, and the project will allow better passage to high quality spawning habitat upstream.

2.7.3 Survival and Recovery

The CV spring-run Chinook salmon ESU is currently limited to independent populations in Mill, Deer, and Butte creeks, with the Yuba River and others serving as dependent populations. This ESU continues to be threatened by habitat loss, degradation and modification, small hydropower dams and water diversions that reduce or eliminate instream flows during migration, unscreened or inadequately screened water diversions, excessively high water temperatures, and predation by non-native species. In the 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 Englebright Dam. Thus, spring-run and fall-run Chinook salmon spawning overlap temporally and spatially (NMFS 2014). Implementation of the Proposed Action is expected to provide to benefit these fish by improving passage through the area and improving rearing habitat, ultimately aiding in the range-wide recovery of these ESUs.

Existing wild steelhead populations in the Sacramento River basin occur in the upper Sacramento River and its tributaries, which includes the Yuba River. NMFS Recovery Plan for CCV steelhead lists the Yuba River steelhead as an independent population with and uncertain population extinction risk. Englebright Dam is currently impassable to steelhead, and thus represents the upstream extend of their range in the Yuba River. Similar to CV spring-run Chinook salmon, implementation of the Proposed Action is expected to provide to benefit these fish by improving passage through the area and improving rearing habitat, ultimately aiding in the range-wide recovery of these ESUs.

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 CCV steelhead or CV spring-run Chinook salmon, or destroy or adversely modify designated critical habitat of these species.

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 incidental take statement (ITS).

2.9.1 Amount or Extent of Take

In the BO, NMFS determined that incidental take is reasonably certain to occur as follows:

NMFS anticipates incidental take of juvenile CCV steelhead and juvenile CV spring-run Chinook salmon to occur in the course of the YCWA South Canal Diversion Water Supply and Fish Passage Enhancement Project. Specifically, NMFS anticipates that juvenile CCV steelhead and juvenile CV spring-run Chinook salmon may be injured and killed as a result of project implementation as they will likely be present in the Action Area during the scheduled work period each year. Adult CCV steelhead may also be in the Action Area during construction, and may be temporarily impacted.

Take of juvenile CCV steelhead and juvenile CV spring-run Chinook salmon may occur if individuals in the construction area are not able to escape, and are then crushed or killed by equipment or personnel. NMFS has estimated take based on preconstruction snorkel surveys for the Hallwood Floodplain Restoration Project, conducted by Cramer Fish Sciences just below Daguerre Point Dam (Cramer Fish Sciences and Cbec Eco Engineering 2016). These surveys were completed February through May, and thus likely overestimate the number of fish that may be found in August and September, when peak immigration periods are over. These surveys found between 0 and 5 juvenile steelhead in each 50 meter transect and no juvenile spring-run Chinook. To calculate the take below, NMFS has used the information from these surveys and the construction footprint of the Proposed Action (447 linear feet). NMFS estimates that only 20% of the fish that may be present will actually be injured and 5% will be killed, as most individuals will be able to escape unharmed. Chinook are more difficult to quantify as they appear to be less numerous than steelhead in this part of the Yuba River; thus NMFS has a made a conservative overestimate that half as many juvenile spring-run Chinook are in the river as juvenile steelhead. Take in the form of injury, or death is summarized below in Tables 2 and 3.

Table 2: Expected take of juvenile CCV steelhead and CV spring-run Chinook salmon due to construction activities during Proposed Action construction in 2018

Species	Life Stage	Expected Injury	Mortality
CCV Steelhead	Juvenile	9	3
CV spring-run Chinook salmon	Juvenile	5	2

Table 3: Expected take of juvenile CCV steelhead and CV spring-run Chinook salmon due to construction activities during Proposed Action maintenance in 2019.

Species	Life Stage	Expected Injury	Mortality
CCV Steelhead	Juvenile	9	3
CV spring-run Chinook salmon	Juvenile	5	2

Adult steelhead may also be impacted by the project through a temporary delay in migration due to the turbidity curtain place across the south channel. However, the number of adult steelhead that pass through the construction area would be very small due to the timing of construction and the lower flows moving through the south channel. The turbidity curtain will be placed 6 inches from the bottom of the stream bed and will be removed at night, meaning such delays would be temporary and would not result in injury or death to adult steelhead. Due to these temporary delays, NMFS expects take in the form of harm to adult steelhead attempting to migrate upstream during daylight hours for the two week construction period between August 6 and September 15, 2018, and the one to ten day maintenance period June 15 to September 15, 2019

2.9.2 Effect of the Take

In the BO, 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 the species or destruction or adverse modification of 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 to minimize sedimentation events 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 to minimize impacts to riparian vegetation in the Action Area and its direct and indirect effects to critical habitat.

3. USACE/the applicant shall prepare and provide NMFS with a yearly report detailing any known take of listed fish species associated with the project.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the USACE or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The USACE 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 the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the Proposed Action will lapse.

1. The following terms and conditions implement Reasonable and Prudent measure 1:

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

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

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. USACE shall submit to NMFS an annual report describing any known incidental take resulting from the Proposed Action, which includes any observations of injured or dead fish as a result of the Proposed Action. This report shall be filed not later than January 1st covering the instream construction window from the previous year. The report should be submitted to the following address:

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

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) USACE should 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 salmonid habitat restoration projects in the Yuba River. Implementation of future restoration projects is consistent with agency requirements set forth in section 7(a)(1).

2.11 Reinitiation of Consultation

This concludes formal consultation for the YCWA South Canal Diversion Water Supply and Fish Passage Enhancement Project.

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 BO, (3) the agency action is subsequently modified in a manner that causes an effect on the listed species or critical habitat that was not considered in this BO, 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 YCWA and descriptions of EFH for Pacific coast salmon contained in the fishery management plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

EFH designated under the Pacific Coast Salmon Fisheries Management Plan (FMP) may be affected by the Proposed Action. Additional species that utilize EFH designated under this FMP within the Action Area include fall-run/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, **(2)** thermal refugia and **(3)** spawning habitat.

3.2 Adverse Effects on Essential Fish Habitat

Effects to the HAPCs listed in section 3.1 above are discussed in context of effects to critical habitat PBFs as designated under the ESA in section 2.5.2. Effects to ESA-listed critical habitat and EFH HAPCs are appreciably similar, therefore no additional discussion is included. A list of adverse effects to EFH HAPCs is included in this EFH consultation. Affected HAPCs are indicated by number corresponding to the list in section 3.1:

Sedimentation and turbidity

- Reduced habitat complexity **(1)**
- Reduced quality and availability of spawning substrate **(3)**
- Reduced delivery of oxygenated water to incubating eggs **(3)**
- Reduced size and connectivity of spawning patches **(1, 3)**
- Increased scouring **(1, 3)**
- Reduced riffle habitat **(1, 3)**

Removal of riparian vegetation

- Degraded water quality **(1, 3)**
- Reduced shading **(2)**
- Reduction in large woody material recruitment **(1)**
- Reduced shelter from predators **(1)**
- Reduction in aquatic macroinvertebrate production **(1)**

3.3 Essential Fish Habitat Conservation Recommendations

The terms and conditions and conservation recommendations in the preceding BO contain adequate measures to avoid, minimize, or otherwise offset the adverse effects to EFH. Therefore, NMFS has no additional EFH conservation recommendations to provide.

3.4 Supplemental Consultation

USACE 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 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 BO addresses these DQA components, documents compliance with the DQA, and certifies that this BO 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. The intended user of this BO is the USACE. Other interested users could include California Department of Fish. Individual copies of this BO were provided to USACE. This BO will be posted on the Public Consultation Tracking System website (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). 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 Appendix III, 'Security of Automated Information Resources,' Office of Management and Budget Circular A-130; the Computer Security Act; and the Government Information Security Reform Act.

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 BO 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.

5. REFERENCES

AECOM. 2015. Yuba Goldfields 200-Year Flood Protection Project Draft Environmental Impact Report, Prepared for the Three Rivers Levee Improvement Authority.

Ayres Associates. 1997. Yuba River Basin, California Project. Geomorphic, Sediment Engineering, and Channel Stability Analysis. U.S. Army Corps of Engineers.

Berg, L. and T. G. Northcote. 1985. Changes in Territorial, Gill-Flaring, and Feeding-Behavior in Juvenile Coho Salmon (*Oncorhynchus Kisutch*) Following Short-Term Pulses of Suspended Sediment. Canadian Journal of Fisheries and Aquatic Sciences 42(8):1410-1417.

California Department of Fish and Game. 1990. Status and Management of Spring-Run Chinook Salmon. Inland Fisheries Division, 33 pp.

California Department of Fish and Game. 1998. A Status Review of the Spring-Run Chinook Salmon (Oncorhynchus Tshawytscha) in the Sacramento River Drainage. Candidate Species Status Report 98-01. California Department of Fish and Game, 394 pp.

California Department of Fish and Wildlife. 2014. Salvage F.T.P. Site.

California Department of Fish and Wildlife. 2016. Grandtab.

Cavallo, B., R. Brown, D. Lee, J. Kindopp, and R. Kurth. 2011. Hatchery and Genetic Management Plan for Feather River Hatchery Spring-Run Chinook Program. Prepared for the National Marine Fisheries Service.

Central Valley Regional Water Quality Control Board. 2016. Water Quality Control Plan, Sacramento and San Joaquin River Basins.

Chase, R. 2010. Lower American River Steelhead (*Oncorhynchus Mykiss*) Spawning Surveys – 2010. Department of the Interior, United States Bureau of Reclamation.

Clark, G. H. 1929. Sacramento-San Joaquin Salmon (*Oncorhynchus Tschawytscha*) Fishery of California. Fish Bulletin 17.

Cramer Fish Sciences and Cbec Eco Engineering. 2016. Hallwood Side Channel and Floodplain Restoration Project Biological and Essential Fish Habitat Assessment.

Dettinger, M. D., Daniel R. Cayan, Mary K. Meyer, Anne E. Jeton. 2004. Simulated Hydrologic Responses to Climate Variations and Changes in the Merced, Carson and American River Basins, Sierra Nevada, California, 1900-2099. Climatic Change 62(62):283-317.

Franks, S. E. 2015. Spring-Running Salmon in the Stanislaus and Tuolumne Rivers and an Overview of Spring-Run Recovery. National Marine Fisheries Service Sacramento, CA.

Garza, J. C. and D. E. Pearse. 2008. Population Genetic Structure of *Oncorhynchus Mykiss* in the California Central Valley: Final Report for California Department of Fish and Game. University of California, Santa Cruz, and National Marine Fisheries Service, Santa Cruz, California.

Gilbert, G. K. 1917. Hydraulic Mining Debris in the Sierra Nevada. US Geological Survey Professional Paper.

Good, T. P., R. S. Waples, and P. Adams. 2005. Updated Status of Federally Listed Evolutionarily Significant Units of West Coast Salmon and Steelhead. NOAA Technical Memorandum NMFS-NWFSC-66.

Hannon, J. and B. Deason. 2008. American River Steelhead (*Oncorhynchus Mykiss*) Spawning 2001 – 2007. U.S. Department of the Interior, Bureau of Reclamation, Mid-Pacific Region.

Hannon, J., M. Healey, and B. Deason. 2003. American River Steelhead (*Oncorhynchus Mykiss*) Spawning 2001 – 2003. U.S. Bureau of Reclamation and California Department of Fish and Game, Sacramento, CA.

Hayhoe, K., D. Cayan, C. B. Field, P. C. Frumhoff, E. P. Maurer, N. L. Miller, S. C. Moser, S. H. Schneider, K. N. Cahill, E. E. Cleland, L. Dale, R. Drapek, R. M. Hanemann, L. S. Kalkstein, J. Lenihan, C. K. Lunch, R. P. Neilson, S. C. Sheridan, and J. H. Verville. 2004. Emissions Pathways, Climate Change, and Impacts on California. Proceedings of the National Academy of Sciences of the United States of America 101(34):6.

Intergovernmental Panel on Climate Change. 2007. Summary for Policymakers: Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. IPCC, 18 pp.

Kemp, P., D. Sear, A. Collins, P. Naden, and I. Jones. 2011. The Impacts of Fine Sediment on Riverine Fish. Hydrological Processes 25(11):1800-1821.

Lindley, S. T., R. S. Schick, A. Agrawal, M. Goslin, T. E. Pearson, E. Mora, J. J. Anderson, B. May, S. Greene, C. Hanson, A. Low, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2006. Historical Population Structure of Central Valley Steelhead and Its Alteration by Dams. San Francisco Estuary and Watershed Science 4(1):19.

Lindley, S. T., R. S. Schick, B. P. May, J. J. Anderson, S. Greene, C. Hanson, A. Low, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2004. Population Structure of Threatened and Endangered Chinook Salmon Evolutionarily Signifcant Units in California's Central Valley Basin. U.S. Department of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-360.

Lindley, S. T., R. S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for Assessing Viability of Threatened and Endangered Chinook Salmon and Steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science 5(1):26.

Liu, Z. and B. Huang. 2000. Cause of Tropical Pacific Warming Trend. Geophysical Research Letters 27(13):1935-1938.

Lloyd, D. S. 1987. Turbidity as a Water Quality Standard for Salmonid Habitats in Alaska. North American Journal of Fisheries Management Vol. 7(1):34–45.

Maslin, P., M. Lennon, J. Kindopp, and W. McKinney. 1997. Intermittent Streams as Rearing of Habitat for Sacramento River Chinook Salmon. California State University, Chico, Department of Biological Sciences.

McCullough, D., S. Spalding, D. Sturdevant, and M. Hicks. 2001. Summary of Technical Literature Examining the Physiological Effects of Temperature on Salmonids. EPA-910-D-01-005.

McEwan, D. and T. A. Jackson. 1996. Steelhead Restoration and Management Plan for California. California Department of Fish and Game, 246 pp.

McEwan, D. R. 2001. Central Valley Steelhead. Fish Bulletin 179(1):1-44.

Mosser, C. M., L. C. Thompson, and J. S. Strange. 2013. Survival of Captured and Relocated Adult Spring-Run Chinook Salmon *Oncorhynchus Tshawytscha* in a Sacramento River Tributary after Cessation of Migration. Environmental Biology of Fishes 96(2-3):405-417.

Moyle, P. B. 2002. Inland Fishes of California. University of California Press, Berkeley and Los Angeles.

National Marine Fisheries Service. 2011a. 5-Year Review: Summary and Evaluation of Central Valley Spring-Run Chinook Salmon. U.S. Department of Commerce, 34 pp.

National Marine Fisheries Service. 2011b. Anadromous Salmonid Passage Facility Design.

National Marine Fisheries Service. 2014. Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead. California Central Valley Area Office.

National Marine Fisheries Service. 2016a. 5-Year Review: Summary and Evaluation of California Central Valley Steelhead Distinct Population Segment. U.S. Department of Commerce.

National Marine Fisheries Service. 2016b. 5-Year Review: Summary and Evaluation of Central Valley Spring-Run Chinook Salmon Evolutionarily Significant Unit. U.S. Department of Commerce.

Nielsen, J. L., S. Pavey, T. Wiacek, G. K. Sage, and I. Williams. 2003. Genetic Analyses of Central Valley Trout Populations 1999-2003. U.S.G.S. Alaska Science Center - Final Technical Report Submitted December 8, 2003. California Department of Fish and Game, Sacramento, California and U.S. Fish and Wildlife Service, Red Bluff, California.

Noakes, D., R. Beamish, L. Klyashtorin, and G. McFarlane. 1998. On the Coherence of Salmon Abundance Trends and Environmental Factors. North Pacific Anadromous Fish Commission Bulletin 1:454-463.

Nobriga, M. and P. Cadrett. 2001. Differences among Hatchery and Wild Steelhead: Evidence from Delta Fish Monitoring Programs. IEP Newsletter 14(3):30-38.

Pasternack, G. B. 2009. Current Status of an on-Going Gravel Injection Experiment on the Lower Yuba River, California.

Petersen, J. H. and J. F. Kitchell. 2001. Climate Regimes and Water Temperature Changes in the Columbia River: Bioenergetic Implications for Predators of Juvenile Salmon. Canadian Journal of Fisheries and Aquatic Sciences 58(9):1831-1841.

Richter, A. and S. A. Kolmes. 2005. Maximum Temperature Limits for Chinook, Coho, and Chum Salmon, and Steelhead Trout in the Pacific Northwest. Reviews in Fisheries Science 13(1):23-49.

Rutter, C. 1904. The Fishes of the Sacramento-San Joaquin Basin, with a Study of Their Distribution and Variation. Pages 103-152 *in* Bill of U.S. Bureau of Fisheries.

Sacramento River Watershed Program. 2015. A Roadmap to Watershed Management, Yuba River Watershed. http://www.sacriver.org/aboutwatershed/roadmap/watersheds/american/yuba-river-watershed.

Servizi, J. A. and D. W. Martens. 1992. Sublethal Responses of Coho Salmon (*Oncorhynchus Kisutch*) to Suspended Sediments Canadian Journal of Fisheries and Aquatic Sciences 49:1389–1395.

Sigler, J. W., T. C. Bjornn, and F. H. Everest. Effects of Chronic Turbidity on Density and Growth of Steelheads and Coho Salmon. Transactions of the American Fisheries Society 113:142-150.

Stachowicz, J. J., H. Fried, R. W. Osman, and R. B. Whitlatch. 2002. Biodiversity, Invasion Resistance, and Marine Ecosystem Function: Reconciling Pattern and Process. Ecology 83(9):2575-2590.

Stewart, I. T., D. R. Cayan, and M. D. Dettinger. 2005. Changes toward Earlier Streamflow Timing across Western North America. Journal of Climate 18(8):1136-1155.

Stone, L. 1872. Report of Operations During 1872 at the United States Salmon-Hatching Establishment on the Mccloud River, and on the California Salmonidae Generally; with a List of Specimens Collected.

Suttle, K. B., M. E. Power, J. M. Levine, and C. McNeely. 2004. How Fine Sediment in Riverbeds Impairs Growth and Survival of Juvenile Salmonids. Ecological applications 14(4):969-974.

SWRCB (State Water Resources Control Board). 2011. Cwa Section 303(D) List of Water Quality Limited Segments. Approved by Epa on December 23, 2011.

Thompson, L. C., M. I. Escobar, C. M. Mosser, D. R. Purkey, D. Yates, and P. B. Moyle. 2011. Water Management Adaptations to Prevent Loss of Spring-Run Chinook Salmon in California under Climate Change. Journal of Water Resources Planning and Management 138(5):465-478.

U.S. Army Corps of Engineers (USACE). 2013. Biological Assessment for the U.S. Army Corps of Engineers Authorized Operation and Maintenance of Existing Fish Passage Facilities at Daguerre Point Dam on the Lower Yuba River.

U.S. Fish and Wildlife Service. 2015. Clear Creek Habitat Synthesis Report USFWS Anadromous Fish Restoration Program, Sacramento, CA

VanRheenen, N. T., Andrew W. Wood, Richard N. Palmer, Dennis P. Lettenmaier. 2004. Potential Implications of Pcm Climate Change Scenarios for Sacramento-San Joaquin River Basin Hydrology and Water Resources. Climatic Change 62(62):257-281.

Waters, T. F. 1995. Sediment in Streams: Sources, Biological Effects, and Control. American Fisheries Society Monograph 7.

YCWA. 2010a. Pre-Application Document, Yuba County Water Agency Yuba River Development Project (Federal Energy Reserve Commision Project No. 2246.).

YCWA. 2010b. Yuba County Water Agency's Comments on the Public Review Draft Recovery Plan for the Evolutionarily Significant Units of Sacramento River Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of Central Valley Steelhead. Federal Register Doc. E9-24224. Filed 10-6-09 Rin 0648 – Xr39. February 2010.

YCWA, DWR, and Bureau of Reclamation. 2007. Draft Environmental Impact Report/Environmental Impact Statement for the Proposed Lower Yuba River Accord. State Clearinghouse (Sch) No: 2005062111. Prepared by Hdr Surface Water Resources, Inc. June 2007.

Yuba Accord Monitoring and Evaluation Program. 2013. Aquatic Resources of the Lower Yuba River, Past, Present & Future. Draft Interim Report.

Yuba County Water Agency. 2017. About Ycwa, Water's Journey. http://www.ycwa.com/about/waters-journey.