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-2018-10773

February 12. 2019

Mike Bartlett
Branch Chief
North Region Environmental Planning M-3
Caltrans, District 3
703 B Street
Marysville, California 95901

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response, and Fish and Wildlife Coordination Act Recommendations for the Atlantic/Eureka Interstate-80 Westbound On-ramp Widening Project

Dear Mr. Bartlett:

Thank you for your letter of communication September 12, 2018, requesting initiation of consultation with the 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 Atlantic/Eureka Interstate (I)-80 Westbound On-ramp Widening Project (Project), in Placer County, California.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA)(16 U.S.C. 1855(b)) for this action.

This biological opinion (BO), is based on the final biological assessment for the Project, and 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 California Central Valley steelhead (*Oncorhynchus mykiss*), and is not likely to destroy or adversely modify their designated critical habitat. NMFS has included an incidental take statement with reasonable and prudent measures and nondiscretionary terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed species associated with the Project.

This letter also transmits NMFS's review of potential effects of the Project on EFH for Pacific Coast salmon, designated under 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 analysis concludes that the Project would adversely affect the EFH of Pacific Coast salmon in the action area. The EFH consultation concludes with conservation recommendations.

NMFS recognizes that Caltrans has assumed the Federal Highway Administration's (FHWA) responsibilities under Federal environmental laws for this project as allowed by a Memorandum of Understanding (NEPA Assignment) with the FHWA effective December 23, 2016. As such, Caltrans serves as the lead Federal Action Agency for the proposed project.

Please contact Lyla Pirkola at the California Central Valley Office of NMFS at (916) 930-5615 or via email at lyla.pirkola@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Maria Rea
Assistant Regional Administrator

Enclosure

cc: To the file 151422-WCR2018-SA00475
Shawn Duffy, Project Biologist, shawn.duffy@dot.ca.gov

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

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

Atlantic/Eureka Interstate-80 Westbound On-ramp Widening Project

NMFS Consultation Number: WCR-2018-10773

Action Agency: California Department of Transportation (Caltrans)

Affected Species and NMFS' Determinations:

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

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

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

Issued By:

Maria Rea
Assistant Regional Administrator
California Central Valley Office

Date: February 12, 2019

TABLE OF CONTENTS

1.0 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 (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 USC 1531 et seq.), and implementing regulations at 50 CFR 402.

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

Because the proposed action would modify a stream or other body of water, NMFS also provides recommendations and comments for the purpose of conserving fish and wildlife resources, and enabling the Federal agency to give equal consideration with other project purposes, as required under the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.).

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. A complete record of this consultation is on file at NMFS California Central Valley Office.

1.2 Consultation History

- On March 21, 2018, NMFS received a letter and Biological Assessment from Caltrans requesting informal consultation on the Atlantic/Eureka Interstate-80 Westbound On-ramp Widening Project (Project).
- On March 31, 2018, NMFS requested additional Project information.
- On April 3, 2018, after receiving additional information, NMFS sent Caltrans a letter stating that we could not concur with Caltrans' determination that the Project was "not likely to adversely affect" listed fish and critical habitat.
- On May 8, 2018 NMFS and Caltrans met onsite to discuss the effects of the Project.
- On September 17, 2018, NMFS received a consultation initiation request letter from Caltrans requesting formal consultation.
- On September 26, 2018, Caltrans provided additional information requested by NMFS via phone and consultation was initiated.

1.3 Proposed Federal Action

Under the ESA, "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).

Caltrans proposes to widen the existing Atlantic Street/Eureka Boulevard/I-80 Westbound On-ramp Bridge to include three lanes. The proposed Project would replace the existing bridge, over Miners Ravine (Bridge No. 190056K). The proposed Project is located within Section 36, Township 11 North, Range 06 East, and Mount Diablo Base and Meridian, of the Roseville Quadrangle. The proposed construction would occur in two stages using half-width construction methods to maintain vehicle traffic flow. During stage 1, the western overhang of the existing bridge would be removed and the replacement western half constructed. In stage 2, the remaining portion of the existing bridge (eastern half) would be removed and the replacement constructed. Construction is anticipated to be completed in two seasons, one stage per season. Work would occur from March 2019 to September 2020 with work suspended in winter months. Instream work would occur only between June 1-October 15. The proposed Project purpose is to increase ramp capacity and reduce traffic impacts.

The proposed replacement of the Miners Ravine Bridge would be three lanes and 48 feet wide. The two existing bridge piers within the ordinary high water mark (OHWM) of Miners Ravine would be removed and replaced with a clear span over Miners Ravine. New bridge abutments would be located farther up the bank and away from the stream, outside the OHWM to improve hydraulic conveyance at the bridge site.

Stage 1 construction will focus on the western half of the ramp bridge and includes:

1. Construction of a 0.083-acre area of temporary water diversion
2. Construction of falsework and debris catching structure for bridge demolition
3. Removal of debris catching structure and placement of falsework for bridge construction
4. Construction of western bridge portion
    - Concrete abutments above OHWM
    - Cast-in-place clear span superstructure
5. Removal of falsework and all water diversion materials using equipment located outside of the stream bank

Stage 2 construction will focus on the eastern half of the ramp bridge and includes all of the same methods and techniques as stage 1. Following the aforementioned steps, a partial fill cofferdam would be used to isolate the former bridge piers. The cofferdam would be constructed of gravel bags with an impermeable layer. Approximately 5 cubic yards of existing concrete column and 5 cubic yards of surrounding earthen material would be removed below existing grade within the channel to achieve 3 feet of below-grade structure removal. After removal of the portions of buried structure, the holes would be backfilled with approximately 10 cubic yards of earthen material, topped with clean spawning sized gravel, and the cofferdam would be removed.

Based on the Project scope, approximately 0.035 acre of riparian habitat would be removed to allow for access to the construction site. The riparian removal sites are divided into six discontiguous locations. Revegetation of grasses would occur onsite for erosion control. Caltrans

proposes to purchase mitigation credits at a 2:1 ratio from a NMFS-approved bank for temporary impacts to riparian vegetation along Miners Ravine.

Proposed staging areas would be located away from the stream in grassland and ornamental vegetation zones near the existing on ramp to minimize environmental impacts. Proposed equipment includes excavators, dozers, cranes, pavers, dump trucks, concrete trucks and concrete pumps.

Immediately prior to in-stream activities or installation of water diversion structures, Caltrans would complete Pre-construction Surveys and Relocation for Salmonids (described below).

Water Diversion and Dewatering
The proposed clear water diversion would consist of a system of structures and measures that intercept clear surface water runoff upstream of a project site, transport it around the work site and discharge it downstream with minimal water quality degradation. Impacted waters located in the work site would either be treated per Storm Water Pollution Prevention Plan (SWPPP) requirements, or disposed of per Regional Water Quality Control Board (RWQCB) requirements. Stream diversion methods would include one or a combination of the following:

- A gravel/rock work pad installed perpendicular to the stream flow with culverts to maintain flow through the work area;
- Culverts installed standing upright into the stream and filled with gravel/rock that support falsework and a temporary bridge that would rest on the culvert pipes; or
- Stream fill of rock/gravel extending partway from the banks on each side of the stream and connected by a temporary bridge (leaving the middle to remain open/flowing).

Any fill material used in association with the dewatering system, such as sandbag fill, would be composed of washed, rounded, spawning sized gravel between 0.4 and 4 inches in diameter. Any gravel that comes in contact with flowing water would be left in place, and distributed manually with hand tools to allow passage for all life stages of fish. Installation and removal of work pads, temporary bridge falsework support, cofferdams, and/or gravel bag berms would be restricted to the summer low-flow period. In between the two work seasons all materials associated with water diversion structures will be removed.

Bridge Abutments
Two existing bridge piers within the OHWM of Miners Ravine would be removed and the replacement would be a clear span over the Miners Ravine. Existing pier removal would not involve a complete removal of pier footings, but rather would involve cutting the footings 3 feet below grade-level within the streambed and leaving below-grade structures in place. This removal would be replaced with approximately 10 cubic yards of earthen backfill material and clean spawning sized gravel.

1.4 Proposed Avoidance and Minimization Measures

- Conduct Environmental Awareness Training for All Construction Personnel:
    - Before any work occurs in the proposed project limits including grading and equipment staging, all construction personnel would participate in an

environmental awareness training regarding special status species and habitat present in the project limits. If new construction personnel are added to the project, they must receive the mandatory training before starting work. As part of the training handouts would be provided describing and illustrating sensitive resources (i.e., riparian habitat, special status species) to be avoided during construction and describing applicable permit conditions identified by NMFS to protect these resources.

- Install Temporary Fencing around Environmentally Sensitive Habitat:
    - Before any ground disturbing activities occur within project limits Caltrans would ensure that temporary construction barrier fencing, silt fencing, and/or flagging is installed between the work area and environmentally sensitive habitat areas.
    - Construction personnel and construction activities would be instructed to avoid areas outside the fencing.
    - The resident engineer in coordination with a NMFS-approved biologist would determine the exact location of the fencing.
    - All fencing/flagging would be checked regularly and maintained until the completion of all construction activity.
- Conduct Biological Monitoring:
    - A NMFS approved biologist would visit the site a minimum of once per week to ensure the fencing has remained in place and that activities are being conducted in accordance with the agreed upon project schedule and agency conditions of approval.
- Return Temporarily Disturbed Areas to Pre-project Conditions:
    - All temporarily disturbed areas would be returned to pre-project conditions within one year following completion of construction.
    - Temporarily disturbed areas would be protected from washout and erosion using appropriate erosion control devices including coir netting, hydroseeding, and revegetation.
- Implement Water Quality Best Management Practices (BMPs):
    - Ground disturbing activities adjacent to and within Miners Ravine would be restricted to the low flow period of June 1-October 15 (work from the existing roadway, top of banks, within falsework, and inside closed cofferdams would occur from March to June)
    - Sediment control measures (sediment fencing, fiber rolls, or equivalent) would be installed between the designated work area and Miners Ravine to ensure construction debris and sediment does not enter the drainage.
    - Caltrans would cover or otherwise stabilize all exposed soil 48 hours prior to potential precipitation events of greater than 0.5 inch.
    - All exposed soil would be stabilized immediately following bridge construction by seeding with native grass seed mix.
    - Refueling, storage, servicing, and maintenance of equipment would take place at least 100 feet from aquatic habitat.
    - All machinery used during construction of the Project would be properly maintained and cleaned to prevent leaks and spills.
- Complete Pre-construction Surveys and Relocation for Salmonids:

    - Immediately prior to in-stream activities or installation of water diversion structures, the following procedures would be used:
        - A NMFS-approved biologist would survey the work area for CCV steelhead.
        - Biologists would seine from the bank out to move fish away from the work area, a seine or fish barrier would be placed to prevent fish from entering the work area, and the work area would be cleared of fish using a dip-net.
        - If CCV steelhead are present they would be captured using dip-nets, placed into shaded aerated buckets, and released downstream into a location with suitable habitat with conditions and water temperatures similar to that of capture location.
        - Handling of CCV steelhead would be minimal, but when necessary the biologist would always wet hands or nets prior to touching fish.
        - Once all fish are removed from the work area, the diversion structure would be placed and additional barrier seines or exclusion fencing would be placed to prevent fish from reentering.
- Dewater the Construction Site and Provide a Clean Water Diversion through the Project Area to Maintain Flows
    - Temporary cofferdams would be used to dewater the construction site and divert water to prevent impeding flow through the work area.
    - When dewatering is required, a NMFS-approved biologist would be present to capture/relocate fish within cofferdams.
    - If dewatering is necessary the work area would be dewatered after removal of all fish and a NMFS-approved screen would be used on any pumps.
    - All cofferdams would be inspected and maintained on a daily basis to ensure integrity for the duration of the season.
- Install Catchment Tarps Prior to any Work Activity to the Bridge within the Stream
    - Prior to any bridge demolition, decommissioning, or work activity within the channel floodway embankments, catchment tarps would be installed to ensure all construction debris is caught and removed daily from the work area.
- Mitigation Banking
    - Caltrans proposes to mitigate for the impacts of the Project by purchasing credits from a NMFS approved mitigation bank at a 2:1 ratio for all temporary effects to habitat, totaling 0.166-acre of mitigation credits at a NMFS-approved fish conservation bank. All features of the conservation bank will be designated critical habitat for steelhead and the bank will be managed, monitored and maintained in perpetuity.
    - Temporary loss of riparian is anticipated to be approximately 0.035-acre divided in six separate locations. Caltrans would revegetate onsite for erosion control only. In order to achieve no net loss of riparian and shaded riverine aquatic (SRA) cover habitat, the offsite compensation or purchase of mitigation credits above will offset temporary loss of riparian and SRA cover.

Under EFH, Federal action means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

Under the Fish and Wildlife Coordination Act (FWCA) an action occurs whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the United States, or by any public or private agency under Federal permit or license" (16 USC 662(a)).

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

2 ENDANGERED SPECIES ACT: OPINION AND INCIDENTAL TAKE STATEMENT

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

2.1 Analytical Approach

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

The designation of critical habitat for species uses 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 opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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

- Identify the range wide 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 Range wide Status of the Species and Critical Habitat

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

The following descriptions of the status of species (Table 1) and conditions of the designated critical habitat (Table 2) in this opinion are a synopsis of the detailed information available from Federal Register notifications, recent status reviews, recovery plans, and population monitoring data.

Table 1. Description of species, current ESA listing classification and summary of species status

Species	Listing Classification and Federal Register Notice	Status Summary
California Central Valley (CCV) Steelhead Distinct Population Segment (DPS)	Threatened, 71 FR 834; January 5, 2006	According to the 5-year species status review (NMFS 2016), the status of CCV steelhead appears to have changed little since the previous status review in 2011 which concluded that the DPS was likely to become endangered within the near future throughout all or a significant portion of its range. Most natural-origin CCV steelhead populations are very small, not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery-origin fish relative to natural-origin fish. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates of CCV steelhead.

Table 2.-Description of critical habitat, designation details and status summary.

Species	Designation Date and Federal Register Notice	Status Summary
California Central Valley (CCV) Steelhead DPS	September 2, 2005, 70 FR 52488	According to the 5-year species status review (NMFS 2016), the Central Valley experienced a severe drought during 2012 through 2015, which likely has reduced the already limited habitat quality. This degraded habitat condition brings about concern that re-establishment of populations may be difficult. The geographical extent of designated critical habitat for CCV steelhead includes stream reaches of the Feather, Yuba and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined the lateral extent will be defined by the bankfull elevation. Physical and biological features considered essential to the conservation of the species include: Spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas.

2.2.1 Global Climate Change

One major factor affecting the range wide status of the threatened and endangered anadromous fish in the Central Valley and aquatic habitat at large is climate change. Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen *et al.* 2000). Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). Projected warming is expected to affect Central Valley steelhead Because the run is restricted to low elevations as a result of impassable rim dams, if climate warms by 5°C (9°F), it is questionable whether CCV steelhead populations can persist (Williams 2006).

CCV steelhead are vulnerable to climate change as they are blocked from the vast majority of their historic spawning and rearing habitat the effects may be even greater in some cases, to juvenile CCV steelhead as they need to rear in the stream for one to two summers prior to emigrating as smolts (Cavallo et al. 2003). In the Central Valley, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile CCV steelhead, which range from 14°C to 19°C (57°F to 66°F).

In summary, observed and predicted climate change effects are generally detrimental to the species (McClure 2011, Wade *et al.* 2013), so unless offset by improvements in other factors, the

status of the species and critical habitat is likely to decline over time. The climate change projections referenced above cover the time period between the present and approximately 2100. While there is uncertainty associated with projections, which increases over time, the direction of change is relatively certain (McClure *et al.* 2013).

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02).

The project is located in the City of Roseville, in southern Placer County, California at the Atlantic Street/Eureka Boulevard /I-80 onramp and the Miners Ravine Bridge. Miners Ravine Bridge (Bridge No. 190056K) is located over Miners Ravine, east of the confluence of Dry Creek and Miners Ravine. The action area ranges from 150 to 200 feet above mean sea level. Approximate coordinates for the bridge are Longitude 121°15'49.24" west and Latitude 38°45'19.69" north using the World Geodetic System 1984 (WGS84).

The action area covers the 15.440-acre project footprint including a 250-foot buffer around project work limits. This 250-foot buffer includes the downstream and upstream extent to which construction effects from turbidity or pollution are expected to occur. Construction will occur over a 500 foot long section of the stream, resulting in effects extending downstream up to 500 feet. Therefore the action area includes the bed and banks of a 1000 foot long length of Miners Ravine.

Because the proposed action includes the purchase of mitigation credits from a conservation bank, the action area also includes the areas affected by the two mitigation banks that have service areas relevant to the project. These include the Fremont Landing Conservation Bank, which is a 100-acre floodplain site along the Sacramento River (Sacramento River Mile 106) and Bullock Bend Mitigation Bank, a 119.65-acre floodplain site along the Sacramento River at the confluence of the Feather River (Sacramento River Mile 80).

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 Status of Listed Species and Critical Habitat in the Action Area

The action area, which encompasses Miners Ravine and associated floodplains and riparian areas at and adjacent to the Project work area, functions primarily as a rearing and migratory habitat for CCV steelhead. Holding post-spawn adults and rearing juveniles may utilize the area on their way to the estuary. Due to the life history timing CCV steelhead, it is possible for one or more of

the following life stages to be present within the action area throughout the year: adult migrants, rearing juveniles, or emigrating juveniles.

The Recovery Plan for the Evolutionary 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 (NMFS 2014, herein referred to as "Recovery Plan") provides a watershed profile for Dry Creek, the watershed to which Miners Ravine belongs. The Recovery Plan identifies the Dry Creek watershed as a Core 3 watershed meaning steelhead populations are present on an intermittent basis, these populations aid in recovery of steelhead by providing genetic diversity and dispersal connectivity to the greater DPS.

The PBFs of CCV steelhead designated critical habitat within the action area include freshwater rearing habitat and freshwater migration corridors. The essential features of these PBFs include: water quality and forage, water quantity and floodplain connectivity, water temperature, riparian habitat, natural cover, and access to and from spawning grounds. The intended conservation roles of habitat in the action area are to provide appropriate freshwater rearing and migration conditions for juveniles and unimpeded freshwater migration conditions for adults. However, the condition and function of this habitat has been severely impaired through several factors, including adjacent agricultural activity, shoreline armoring, removal of riparian and wetland vegetation, and removal of woody debris. Similar activities throughout the Miners Ravine watershed have resulted in degradation of these PBFs across the entire region. Conditions for juvenile rearing in the action area are poor and likely contribute to reduced growth and survival of steelhead.

2.4.2 Factors Affecting Listed Species and Critical Habitat in the Action Area

Miners Ravine has been degraded from its historic condition and many anthropomorphic and naturally occurring factors have led to the decline of anadromous fish in the surrounding ecosystem. Due to the construction of Cottonwood Dam as well as various other barriers to passage including beaver dams, flows and temperatures through the action area have been altered from their natural and historic regimes. Altered flow regimes can influence migratory cues, water quality (including contaminants, dissolved oxygen, and nutrients for primary productivity), sedimentation and water temperature. Dams convert riverine habitat into pools, which alters downstream flow rates for water and sediment. In addition, dams impede movement of aquatic organisms. Affected water quality results in long-term changes to downstream channels, riparian zones, and floodplains (NRC 1996, Nilsson and Dynesius 1994).

The action area currently includes a bridge with in-channel abutments within critical habitat. The areas surrounding the portion of Miners Ravine that flows through the action area have been heavily urbanized. Anthropogenic influence within the floodplain creates additional problems in the watershed. Many homes have landscaped backyards that come to the edge of the creek. The run-off from landscaped yards may contain chemicals from fertilizers, animal waste, and other contaminants that have a detrimental effect on water quality and this could affect all life stages of salmonids (CDFW 1989, NRC 1996). These residential influences also affect the natural process of erosion, which in turn decreases the recruitment of gravel back into the system. Creek banks

near homes are typically buffered with riprap, which allows only fine sediment to enter the creek (Swanson 1992).

Riparian vegetation provides a large host of ecosystem services and its removal has diminished habitat value within the action area. Riparian vegetation plays a key role in the conservation value of rearing habitat for all salmonid life stages. It provides shading to lower stream temperatures; increases the recruitment of large woody material into the river, increasing habitat complexity; provides shelter from predators and; enhances the productivity of aquatic macroinvertebrates (Anderson and Sedell 1979, Pusey and Arthington 2003). It has also been shown to directly influence channel morphology and may be directly correlated with improved water quality in aquatic systems (Schlosser and Karr 1981, Dosskey *et al.* 2010). The mean percent of in-stream cover in Miners Ravine is very low for all three present habitat types-13% for glides, 7% for pools, and 10% for riffles (DWR 2002) the Salmonid Stream Habitat Restoration Manual indicates optimal in-stream cover for pool complexes would be 100% (Flossi et al 1998). The low percentages indicate poor quality cover, which affects the ability of fish to take refuge from both terrestrial and aquatic predators, refuge from high flow velocities, as well as refuge from bright sunlight (Reiser and Bjornn 1979, Vanicek 1993, Moyle 2002).

2.4.3 *Conservation Banks*

Conservation banks present a unique factual situation, and this warrants a particular approach as to how they are addressed. Specifically, when NMFS is consulting on a proposed action that includes conservation bank credit purchases, it is likely that physical restoration work at the bank site has already occurred and/or that a Section 7 consultation occurred at the time of bank establishment. A traditional interpretation of the "environmental baseline" might suggest that the overall ecological benefits of the conservation bank actions therefore belong in the baseline. However, under this interpretation, all proposed actions, whether or not they included proposed credit purchases, would benefit from the environmental 'lift' of the entire conservation bank because it would be factored into the environmental baseline. In addition, where proposed actions did include credit purchases, it would not be possible to attribute their benefits to the proposed action, without double-counting. These consequences undermine the purposes of conservation banks and also do not reflect the unique circumstances under which they are established. Specifically, conservation banks are established based on the expectation of future credit purchases. In addition, credit purchases as part of a proposed action will also be the subject of a future Section 7 consultation. It is therefore appropriate to treat the beneficial effects of the bank as accruing incrementally at the time of specific credit purchases, not at the time of bank establishment or at the time of bank restoration work. Thus, for all projects within the service area of a conservation bank, only the benefits attributable to credits sold are relevant to the environmental baseline. Where a proposed action includes credit purchases, the benefits attributable *to those credit purchases* are considered in the effects of the action.

The proposed construction occurs within the service areas of two conservation or mitigation banks approved by NMFS. Both these banks occur within critical habitat for CCV steelhead. These include:

Fremont Landing Conservation Bank: Established in 2006, the Fremont Landing Conservation Bank is 100-acre floodplain site along the Sacramento River (Sacramento River Mile 106) and is approved by NMFS to provide credits for impacts to SR winter-run Chinook salmon, CV spring-run Chinook salmon and CCV steelhead. There are off-channel shaded aquatic habitat credits, riverine shaded aquatic habitat credits and floodplain credits available. To date, there have been about 60 of 100 credits sold and the ecological value (increased rearing habitat for juvenile salmonids) of the sold credits are part of the environmental baseline. Additional transactions may be pending but given the uncertainty, associated benefits are not considered part of the environmental baseline. All features of this bank are designated critical habitat for the species analyzed in this opinion.

Bullock Bend Mitigation Bank: Established in 2016, the Bullock Bend Mitigation Bank is a 119.65-acre floodplain site along the Sacramento River at the confluence of the Feather River (Sacramento River Mile 80) and is approved by NMFS to provide credits for impacts to SR winter-run Chinook salmon, CV spring-run Chinook salmon and CCV steelhead. There are salmonid floodplain restoration, salmonid floodplain enhancement and salmonid riparian forest credits available. To date, there have been about 85 of 116.15 credits sold and the ecological value (increased rearing habitat for juvenile salmonids) of the sold credits are part of the environmental baseline. Additional transactions may be pending but given the uncertainty, associated benefits are not considered part of the environmental baseline. All features of this bank are designated critical habitat for the species analyzed in this opinion.

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 caused by the proposed action and are later in time, but still are reasonably certain to occur.

The proposed action includes activities that are likely to directly or indirectly impact CCV steelhead and/or their designated critical habitat. The following is an analysis of the potential direct and indirect effects to the species and/or their critical habitat that may occur because of implementing the Project, including fish capture and relocation; construction related effects; sedimentation and turbidity effects; spills and hazardous materials; overwater structure; and effects to critical habitat.

2.5.1 Fish Capture and Relocation

To minimize direct and indirect mortality of fishes from construction activities, any fish within the immediate work site (approximately 500 feet of channel) will be relocated. A full description of fish relocation procedures are described above in *Proposed Federal Action* section. Fish relocation will first be attempted using herding since this method is expected to have the lowest impact on the species, avoiding handling and transport stress.

If fish cannot be herded, they will be collected using seining or dip netting. Fish relocation activities pose a risk of injury or mortality to rearing juvenile steelhead since any fish relocation or collection gear has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of unintentional injury and mortality attributable to fish relocation varies widely depending on the method used, ambient conditions, and the experience of the field crew. Since fish relocation activities will be conducted by qualified fisheries biologists following NMFS guidelines, direct effects to and mortality of juvenile steelhead during relocation activities is expected to be minimal.

Sites selected for relocating fish will have similar water temperature and provide similar suitable habitat as that of the capture site. However, relocated fish may endure short-term stress from crowding at the relocation site. Relocated fish may also have to compete with resident fish for available resources such as food and habitat. Some of the fish released at the relocation site will likely move upstream or downstream to areas that have more habitat and a lower density of fish. As each fish disperses, competition diminishes and remains localized in a small area. The number of fish affected by competition cannot be accurately estimated, due to variability in fish presence or absence in any given area, but it is unlikely that this impact will cascade through the population within the watershed based on the small area that will be affected and the small number of CCV steelhead that will need to be relocated.

Juvenile steelhead that evade capture and remain in the construction area may be injured or killed from construction activities. This includes desiccation if fish remain in the dewatered area, or death if fish are crushed by personnel or equipment. However, because experienced biologists will be collecting fish, most are expected to be removed from the area before construction. Juvenile CCV steelhead may be present during relocation, and thus subject to the above effects. Adult CCV steelhead are not expected to be present during relocation, and thus impacts to this life stage of these species is considered improbable.

2.5.2 Construction Related Effects

Construction-related activities have the potential to result in injury or death to listed fish species. Construction-related effects may include debris falling into the active channel, tools and/or equipment falling into the active channel, or noise generated by displaced rock and sediment and the operation of construction machinery. Both adult and juvenile life stages of CCV steelhead can potentially utilize the action area as a migration corridor and may exhibit rearing behavior there as well. Any of these species/life stages may be present during the scheduled in-water work window and may be adversely affected by construction-related effects. BMPs, and avoidance and minimization techniques will be implemented, minimizing the probability and severity of construction-related effects in the action area.

Juvenile or adult steelhead that migrate through the project area may be exposed to short-term noise and disturbance caused by construction activities. For juveniles this may cause stress from being displaced from their rearing area and needing to locate a new rearing area. As such, juvenile steelhead may experience crowding and competition with resident fish for food and habitat, which can lead to reduced growth. Further, juvenile steelhead may be subject to increased predation risk while they are locating to new rearing areas, leading to reduced survival.

However, we expect displaced adult and juvenile fish will likely relocate to areas downstream that have suitable habitat and low competition. A small number of listed species are likely to be in the action area and temporarily displaced by the proposed Project actions. However, it is not expected that these actions will negatively impact the survival chances of the population as a whole.

Instream construction activities may cause mortality or reduce abundance of benthic aquatic macroinvertebrates within the footprint of the bridge repairs, due to coarse sediment smothering. These effects to aquatic macroinvertebrates are expected to be temporary, as rapid recolonization (about 2 weeks to 2 months) is expected (Merz and Chan 2005). Furthermore, downstream drift is expected to temporarily benefit any downstream, drift-feeding organisms, including juvenile listed species. The amount of food available for adult and juvenile CCV steelhead in the action area is therefore expected to return to at least to pre-Project conditions.

Although CCV steelhead may be exposed to the construction area with reduced prey base, individuals will be able to retreat to adjacent suitable habitat, and affected food resources are expected to begin to recolonize as soon as construction is completed. Therefore, effects of instream construction activities are expected to be minor and are unlikely to result in injury or death.

2.5.3 *Sedimentation and Turbidity Effects*

Increased sedimentation and turbidity in Miners Ravine may result from a number of sources associated with the proposed Project. Site clearing, earthwork, vegetation removal and planting, and removal of bridge piers within the OHWM will result in disturbance of soil and riverbed sediments and therefore temporary increases in turbidity and suspended sediments. Disturbance of sediments during in-water construction could lead to a degradation of water quality. In addition, installation of water diversion structures could result in temporary increases in turbidity and suspended sediments in the river, if water from within cofferdams is not properly disposed of or contained and treated before discharge back to the river.

Increased exposure to elevated levels of suspended sediments have the potential to result in physiological and behavioral effects. The severity of these effects depends on the extent of the disturbance, 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.

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.* 1984). 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).

Any increase in turbidity associated with proposed instream work is likely to be brief and localized, attenuating downstream as suspended sediment settles out of the water column.

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 (e.g., Sigler *et al.* 1984, Lloyd 1987, Servizi and Martens 1992).

Potential direct and indirect effects of increased sedimentation and turbidity will be minimized through implementation of proposed BMPs. All in water work will be conducted between June 1 and October 15 to minimize impacts to fish. To prevent the potential discharge of turbid water into the Sacramento River that may result from temporary de-watering activities, water removed from the de-watered areas will be filtered and/or treated in a manner to ensure conformance with the water quality requirements of the approved 401 permit, issued by the Central Valley RWQCB, prior to being discharged into the aforementioned receiving waters. There is still some potential for impact to adult and juvenile fish due to temporary, localized plumes of turbidity during these processes. However, BMP actions will minimize the extent of adverse effects associated with the proposed action and impacts to fish are expected to be minimal.

2.5.4 *Spills and Hazardous Materials*

During construction, the potential exists for spills or leakage of toxic substances to enter Miners Ravine. Refueling, operation, and storage of construction equipment and materials could result in accidental spills of pollutants (e.g., fuels, lubricants, concrete, sealants, and oil).

High concentrations of contaminants can cause direct and indirect effects to fish. Direct effects include mortality from exposure or increased susceptibility to disease that reduces the overall health and survival of the exposed fish. The severity of these effects depends on the contaminant, the concentration, duration of exposure, and sensitivity of the affected life stage. A potential indirect effect of contamination is reduced prey availability; invertebrate prey survival could be reduced following exposure, therefore making food less available for fish. Fish consuming infected prey may also absorb toxins directly.

For CCV steelhead, potential direct and indirect effects of reduced water quality during Project construction will be minimized with proposed BMPs including measures to control non-storm water management and waste management practices. Equipment will be in good working order and free of dripping or leaking fluids. Any necessary equipment washing will be conducted where water is prevented from flowing into the drainage conveyance systems and receiving waters. An emergency response plan will also be put into place including strict onsite handling procedures to prevent construction and maintenance materials from entering the river, procedures related to refueling, operating, storing, and staging construction equipment, as well as preventing and responding to spills. BMPs will be in place for spill containment measures. Returning turbid water to the river will be prevented by filtering discharge with a filter bag, diverting to a settling tank and treatment of the water consistent with the requirements of the waste discharge permit issued by the Central Valley RWQCB. With these BMPs in place, impacts to adult or juvenile CCV steelhead from contaminants are expected to be very minor and short-term.

2.5.5 Overwater Structure

The construction of the new bridge structure (30 feet wider than existing) will add permanent shading to Miners Ravine. Overwater structures can alter underwater light conditions and provide potential holding conditions for juvenile and adult fish, including species that prey on juvenile fishes. Shading also could increase the number of predatory fishes (e.g., striped bass, largemouth bass) holding in the action area and/or their ability to prey on juvenile fishes. Permanent shading effects will occur throughout the life of the bridge. Construction of the new bridge will result in a total of 0.2 acre of permanent shading. Because there are adjacent areas for CCV to rear, the effects of the shade cause by the new structure would be minimal.

2.5.6 Effects to Critical Habitat

Critical habitat has been designated in the action area for CCV steelhead. The PBFs of critical habitat within the action area for CCV steelhead are (1) freshwater rearing sites; and (2) freshwater migration corridors.

Migratory corridor PBFs for CCV steelhead are likely to be affected by the proposed action. In-stream work is expected to temporarily affect a 1000 foot length of critical habitat, with an instream footprint of a maximum of 0.083 acres critical habitat. Impacts are expected to include minor decreases in the flow regime and slight increases in temperatures. During the two separate seasons of in-water work, the width of the channel within the migratory corridor will be decreased, but the long-term project footprint is expected to result in an increase to usable area for fish migration as existing in-stream pier footings will be removed and the new bridge will span the entirety of the stream. Additionally Caltrans will purchase mitigation credits at a NMFS approved bank at a 2:1 ratio for the 0.083 acre of instream habitat impact.

The wider new bridge will continue to shade the Sacramento River by a total of 0.2 of an acre. This will degrade the PBF of migratory corridors by increasing the predation risk. Overwater structures can alter underwater light conditions and provide potential holding conditions for juvenile and adult fish, including species that prey on juvenile listed fishes.

Water quality may be temporarily affected due to increased turbidity during removal of bridge piers and during cofferdam dewatering which could cause a temporary drop in oxygen levels. This will affect the migratory PBF component for adequate flow. These effects as well as construction debris, runoff, and dust affecting water quality, will be prevented through the implementation of aforementioned BMPs and spill prevention measures and an emergency response plan. These BMP actions will minimize the extent of adverse effects associated with the proposed action and impacts to critical habitat are expected to be minimal and temporary.

In addition, this Project will temporarily remove 0.035 acres of riparian habitat that supports rearing PBFs of critical habitat. BMPs will be implemented to minimize temporary effects; all disturbed areas will be returned to pre-project conditions within one year following completion of construction. These areas will be protected from washout using appropriate erosion control devices, hydroseeding, and revegetation. Immediately following Project completion all exposed

soil will be stabilized by seeding with native grass seed. Rapidly sprouting plants will be cut off at ground level to allow root systems to remain intact and natural revegetation is expected to occur within a few years. Short-term impacts to critical habitat are minimal and the purchase of mitigation credits will provide a long-term benefit for CCV steelhead PBFs. This benefit will also be provided in the short term as the purchase of credits at a mitigation bank ensures immediate and effective critical habitat benefits. These benefits are ensured as the bank is managed, monitored, and maintained in perpetuity.

2.5.7 Mitigation/Conservation Bank Credit Purchases

To address impacts of the proposed action to riparian and aquatic habitats, the proposed action includes purchase of mitigation bank credits at a 2:1 ratio for permanent riparian and aquatic habitat impacts. Both the riparian and aquatic habitat impacts affect designated critical habitat, as well as listed fish species, described above in this BO. The purchase of mitigation credits will address the loss of ecosystem functions due to the modification of the riverbank. These credit purchases are ecologically relevant to the PBFs of critical habitat and the species affected by the proposed action because both banks include shaded riparian aquatic, riparian forest and floodplain credits with habitat values that are already established and meeting performance standards. Also, the banks are located in areas that will benefit the ESUs/DPSs affected. The purchase of mitigation credits at one of these banks is expected to benefit the PBFs of freshwater rearing habitat and migration corridors for juvenile salmon and steelhead by providing suitable floodplain and riparian habitat. The floodplains and riparian forest in the bank benefit the growth and survival of rearing salmonids by providing habitat with abundant food in the form of aquatic invertebrates, structural diversity such as instream woody material (IWM), and cooler stream temperatures.

The purchase of credits provides a high level of certainty that the benefits of a credit purchase will be realized because both of the NMFS approved banks considered in this opinion have mechanisms in place to ensure credit values are met over time. Such mechanisms include legally binding conservation easements, long-term management plans, detailed performance standards, credit release schedules that are based on meeting performance standards, monitoring plans and annual monitoring reporting to NMFS, non-wasting endowment funds that are used to manage and maintain the bank and habitat values in perpetuity, performance security requirements, a remedial action plan, and site inspections by NMFS. In addition, each bank has a detailed credit schedule and credit transactions and credit availability are tracked on the Regulatory In-lieu fee and Bank Information Tracking System (RIBITS). RIBITS was developed by the USACE with support from the Environmental Protection Agency, the U.S. Fish and Wildlife Service, the Federal Highway Administration, and NMFS to provide better information on mitigation and conservation banking and in-lieu fee programs across the country. RIBITS allows users to access information on the types and numbers of mitigation and conservation bank and in-lieu fee program sites, associated documents, mitigation credit availability, service areas, as well information on national and local policies and procedures that affect mitigation and conservation bank and in-lieu fee program development and operation.

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).

2.6.1 Water Diversions

Water diversions for municipal and industrial use are found in action area. Depending on the size, location, and season of operation, any of the diversions that are unscreened may entrain and kill many life stages of aquatic species, including juvenile listed anadromous fish species.

2.6.2 Increased Urbanization

Increases in urbanization and housing developments can affect habitat by altering watershed characteristics, and changing both water use and storm water runoff patterns. Increased growth will place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions, particularly those that are situated away from waterbodies, will not require Federal permits, and thus will not undergo review through the ESA consultation process with NMFS.

2.6.3 Rock Revetment and Levee Repair Projects

Cumulative effects include non-Federal riprap projects. Depending on the scope of the action, some non-Federal riprap projects carried out by state or local agencies do not require Federal permits. These types of actions and illegal placement of riprap occur within Miners Ravine. The effects of such actions result in continued degradation, simplification and fragmentation of riparian and freshwater habitat.

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 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.

In our *Range wide Status of the Species* section, NMFS summarized the current likelihood of extinction for CCV steelhead. We described the factors that contribute to the continued listing of CCV steelhead under the ESA and across their ranges. These factors include past and present human activities, climatological trends, and ocean conditions that have been identified as influential to the survival and recovery of the listed species. Beyond the continuation of the human activities affecting the species, we also expect that ocean condition cycles and climatic shifts will continue to have both positive and negative effects on the species' ability to survive and recover. The *Environmental Baseline* section reviewed the status of the species and the factors that are affecting their survival and recovery in the action area. The *Effects of the Action* section reviewed the exposure of the species and critical habitat to the proposed action. NMFS then evaluated the likely responses of individuals, populations, and critical habitat. The *Cumulative Effects* section described future activities within the action area which are reasonably certain to have a continued effect on steelhead. This *Integration and Synthesis* section will consider all of these factors to determine the proposed action's influence on the likelihood of both the survival and recovery of the listed species, and on the value of designated critical habitat for the conservation of the species.

In order to estimate the risk to CCV steelhead a result of the proposed action, NMFS uses a hierarchical approach. The condition of the DPS is summarized from the *Status of the Species* section of this opinion. We then consider how the status of populations in the action area, as described in the *Environmental Baseline*, are affected by the proposed action. Effects on individuals are summarized, and the consequence of those effects is applied to establish risk to the DPS.

Status of the Species

The status of the CCV steelhead DPS appears to have remained unchanged since the 2016 status review and the DPS is likely to become endangered within the near future throughout all or a significant portion of its range (NMFS 2016a). Many of the PBFs of CCV steelhead critical habitat are degraded and provide limited high quality habitat. Although the current conditions of CCV steelhead critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in the Central Valley are considered to have high intrinsic value for the conservation of the species, as they are critical to ongoing recovery efforts.

Cumulative Effects

Water diversions, increased urbanization, and continuing rock revetment can be reasonably assumed to occur in the future in the action area. The effects of these actions result in the continued degradation, simplification, and fragmentation of the riparian and freshwater habitat. Some of these actions, particularly those that are situated away from waterbodies, will not require Federal permits, and thus will not undergo review through the ESA section 7 consultation process with NMFS.

Summary of the Effects of the Proposed Action

CCV steelhead will be harassed, injured, or killed during completion of the proposed action through various pathways. Direct effects from Project activities are expected to result in negative effects through behavioral responses, or prey items killed from sediment or pollutant buildup. Any spills or leaks of toxic substances from construction equipment are expected to cause direct or indirect effects to fish that risk mortality or reduces the overall health and survival of exposed fish. Construction-related increases in sedimentation and siltation above background level are expected to affect fish species and their habitat reducing survival of juveniles or interfering with feeding, migrating, and rearing activities. Avoidance and mitigation measures, as well as BMPs, have been put in place to minimize negative effects to listed species. The implementation of the capture and relocation plan is expected to increase risks to fish, resulting in a small number injuries and death.

Critical habitat has been designated in the action area for CCV steelhead. PBFs affected include migratory corridor and rearing. The proposed action will temporarily affect the action area, which already contains degraded PBFs. The migratory corridors and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species. Therefore, the loss of any amount of these PBFs in the action area is expected to negatively affect CCV steelhead that utilize the action area.

NMFS Recovery Plan

The Recovery Plan (NMFS 2014) for salmonids recommends recovery actions to be taken in the Dry Creek watershed to enhance fish passage and habitat. Four actions relevant to the proposed action are (1) Enhance watershed resiliency in Dry Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas. (2) Utilize biotechnical techniques that integrate riparian restoration for riverbank stabilization instead of conventional riprap. (3) Curtail further development in Dry Creek floodplains through zoning restrictions, county master plans, and other Federal, State, and county planning and regulatory processes. (4) Improve instream refuge cover for salmonids in Dry Creek to minimize predatory opportunities for striped bass and other non-native predators.

The proposed Project creates 0.2-acre of permanent shading in Miners Ravine; this shading creates predation opportunities for non-native predators of CCV steelhead. Although the construction of the new clear span bridge decreases in-channel structure components in Miners Ravine, this structure represents new development in Dry Creek watershed floodplains, which contributes to habitat degradation and is expected to negatively affect CCV steelhead.

Summary – Risks to DPS

According to the most recent status reviews, CCV steelhead are at some level of threat or risk of extinction due to past and present activities within Miners Ravine that have caused significant habitat loss, degradation, and fragmentation. Cumulative effects like water diversions, increased urbanization, and continuing rock projects will all continue to happen in the action area without necessarily requiring Federal permitting. During this proposed Project, fish are expected to be harassed, injured, or killed during completion of the proposed action through various pathways. Construction related effects from the Project as well as pollution events, dewatering and fish capture and relocation, turbidity increases, increased shading, and a loss of critical habitat all have the potential to affect fish. Avoidance and mitigation measures, as well as BMPs, have been put in place to decrease any negative effects to listed species.

The proposed construction will temporarily decrease the action area's ability to safely support CCV steelhead at a variety of life stages and will increase the risk of mortality events or behavioral changes. A total of 0.2 acre of critical habitat will be permanently affected in shading from the bridge. These rearing and migratory corridor PBFs that support CCV steelhead will be negatively impacted through bridge shading. These permanent impacts only represent a small loss in the scope of the available habitat for CCV steelhead, but the intrinsic value of the area for the conservation of fish remains high. Onsite mitigation will minimize the loss of ecosystem function due to the modification of the riverbank and streambed (see section 1.3). Measures are included in the proposed action to protect fish and designated critical habitat. The proposed Project, with the implementation of these measures and the purchase of mitigation credits at a NMFS-approved mitigation bank, is not expected to reduce appreciably the likelihood of either the survival or recovery of CCV steelhead in the wild by reducing their numbers, reproduction, or distribution; or appreciably diminish the value of designated critical habitat for the conservation of the species.

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' opinion that the proposed action is not likely to jeopardize the continued existence of CCV steelhead or destroy or adversely modify their designated critical habitats.

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted

by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1 Amount or Extent of Take

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

NMFS anticipates incidental take of juvenile CCV steelhead from impacts directly related to dewatering and potential fish entrainment. Incidental take is reasonably certain to occur in each of the two in-water work window seasons.

It is impossible to precisely quantify and track the amount or number of individuals that are expected to be incidentally taken (injure, harm, kill, etc.) as a result of the proposed action due to the variability and uncertainty associated with the response of CCV steelhead to the effects of the proposed action, the varying population size, annual variations in the timing of spawning and migration, individual habitat use within the action area, and difficulty in observing injured or dead fish. However, it is possible to estimate the extent of incidental take by designating as ecological surrogates, those elements of the Project that are expected to result in incidental take, that are more predictable and/or measurable, with the ability to monitor those surrogates to determine the extent of take that is occurring.

Ecological surrogates are Project elements that are expected to result in take and are predictable and/or measurable. Ecological surrogates can be monitored to approximate the level of take that occurs. Ecological surrogates for construction effects are described below. Overall, the number of listed fish incidentally taken during activities is expected to be small, due to BMPs such as implementing the proposed work window.

1) Fish Entrapment in Cofferdams and Downstream Effects

The proposed Project involves cofferdams used for the removal of the existing bridge piers. Dewatering will occur over 0.083 acres over several months for two separate seasons. A fish capture and relocation plan will be designed to recover any fish caught in cofferdams. It is impossible to estimate how many fish may need to be relocated from cofferdams or may be affected due to dewatering. NMFS expects that fish will become entrained during dewatering and may be injured or killed during relocation. The cofferdams are to remain in place only during construction of the new bridge piers and will be removed between construction seasons. The size of the dewatered section is the ecological surrogate for these effects because it is where relocation or dewatering will directly affect steelhead. If Caltrans exceeds the 0.083 acre cofferdam footprint, the proposed Project will be considered to have exceeded anticipated take levels, thus requiring Caltrans to cease operations and coordinate with NMFS within 24 hours on ways to reduce the amount of take down to anticipated levels.

Water quality is also expected to be temporarily affected over the 1000 foot length of stream in the action area due to increased turbidity during removal of bridge piers and during cofferdam

dewatering which could cause a temporary drop in oxygen levels. These water quality effects are expected to cause harm to juvenile and adult steelhead in the form of reduced fitness. This 1000 foot area is the ecological surrogate for downstream impacts because it is where turbidity and water quality will indirectly affect steelhead. If Caltrans exceeds the 1000 foot length of stream, the proposed Project will be considered to have exceeded anticipated take levels, thus requiring Caltrans to cease operations and coordinate with NMFS within 24 hours on ways to reduce the amount of take down to anticipated levels.

2) Overwater Structure Impacts

NMFS anticipates that CCV steelhead will be harmed as a result of shading by the new structure over the Sacramento River. This shading is expected to reduce the primary productivity of affected habitats and increase the number of predatory fishes holding in the action area and/or their ability to prey. The ecological surrogate for incidental take associated with the action is the permanent shading of 0.2 acres of the Sacramento River in the action area, which is appropriate because it is where shading will directly affect CCV steelhead.

Anticipated incidental take will be exceeded if: (1) the ecological surrogates described in the sections above continue to be exceeded after additional measures (in coordination with NMFS) have been taken; (2) the Proposed Action is not implemented as described in the prepared BA; (3) all conservation measures are not implemented as described in the BA (including successful completion of monitoring and reporting criteria); or (4) the Action is not implemented in compliance with the terms and conditions of this incidental take statement.

2.9.2 *Effect of the Take*

In the opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to 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 incidental take associated with capturing and relocating juvenile CCV steelhead.
2. Measures shall be taken by Caltrans to minimize impacts to designated critical habitat and to mitigate for unavoidable impacts.
3. Caltrans shall provide a report of project activities to NMFS by December 31 of each construction year.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and Caltrans or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). Caltrans 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 would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:
    a. All aspects of fish relocation shall be supervised by at least one NMFS-approved biologist who will be personally on-site throughout each phase of the capture and relocation.
    b. A written plan for fish relocation specific to this project and approved by NMFS shall be utilized for all dewatering, capture, and relocation activities. The plan shall be thoroughly understood by all individuals that are to be involved and operations shall be conducted in strict accordance with the written plan.
2. The following terms and conditions implement reasonable and prudent measure 2:
    a. Caltrans shall purchase mitigation credits at a NMFS approved conservation bank at a 2:1 ratio for permanent impacts to critical habitat in the action area associated with this project.
3. The following terms and conditions implement reasonable and prudent measure 3:
    a. A report shall include a summary description of in-water construction dates and activities, avoidance and minimization measures taken, mitigation credits purchased, and any revegetated areas on-site. Updates and reports required by these terms and conditions shall be submitted by December 31 of each year during the construction period to:

        Maria Rea
        Central Valley Office
        National Marine Fisheries Service
        650 Capitol Mall, Suite 5-100
        Sacramento CA 95814
        FAX: (916) 930-3629
        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) Caltrans 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.
(2) Pier footings should be removed to a depth of 3 feet and backfilled with spawning size gravel.
(3) Equipment used for the Project should be thoroughly inspected off-site for drips or leaks.
(4) To the extent practicable, equipment should be serviced with petroleum or other contaminant sources off-site.
(5) Equipment used for the Project should be thoroughly cleaned off-site to prevent introduction of contaminants.

2.11 Reinitiation of Consultation

This concludes formal consultation for Atlantic I-80 Westbound On-ramp 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 opinion, (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 opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. The MSA (section 3) defines EFH as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) also requires NMFS to recommend measures that can be taken by the Action Agency to conserve EFH.

This analysis is based, in part, on the EFH assessment provided by Caltrans and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

EFH designated under the Pacific Coast Salmon FMP may be affected by the proposed action. Species that utilize EFH designated under this FMP within the action area include fall-run Chinook salmon. The HAPC that may be either directly or indirectly adversely affected include (1) complex channels and floodplain habitats and (2) thermal refugia.

3.2 Adverse Effects on Essential Fish Habitat

Consistent with the ESA portion of this document which determined that aspects of the proposed action will result in impacts to pacific coast salmonids and critical habitat, we conclude that aspects of the proposed action would also adversely affect EFH for these species. We conclude that the following adverse effects on EFH designated for Pacific Coast Salmon are reasonably certain to occur:

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

Contaminants and Pollution-related Effects
- Degraded water quality (1, 2)
- Reduction in aquatic macroinvertebrate production, or bioaccumulation in prey (1)

Vegetation removal:
- Permanent loss of natural shade cover (2)
- Permanent loss of habitat (1)

De-watering of cofferdams
- Degraded water quality (1, 2)

• Temporary loss of habitat (1, 2)

3.3 Essential Fish Habitat Conservation Recommendations

The following are EFH conservation recommendations for the proposed Project:

(1) Caltrans should provide a NMFS-approved Worker Environmental Awareness Training Program for construction personnel to be conducted by a NMFS-approved biologist for all construction workers prior to the commencement of construction activities. The program should provide workers with information on their responsibilities with regard to federally-listed fish, their critical habitat, an overview of the life-history of all the species, information on take prohibitions, protections under the ESA, and an explanation of terms and conditions identified in this BO. Written documentation of the training should be submitted to NMFS within 30 days of the completion of training.

Fully implementing these EFH conservation recommendations would protect EFH for Pacific coast salmon by avoiding or minimizing the adverse effects described in section 3.2, above.

3.4 Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, Caltrans must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation. Such a response must be provided at least 10 days prior to final approval of the action if the response is inconsistent with any of NMFS' EFH Conservation Recommendations unless NMFS and the Federal agency have agreed to use alternative time frames for the Federal agency response. The response must include a description of measures proposed by the agency for avoiding, minimizing, mitigating, or otherwise offsetting the impact of the activity on EFH. In the case of a response that is inconsistent with the Conservation Recommendations, the Federal agency must explain its reasons for not following the recommendations, including the scientific justification for any disagreements with NMFS over the anticipated effects of the action and the measures needed to avoid, minimize, mitigate, or offset such effects (50 CFR 600.920(k)(1)).

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

3.5 Supplemental Consultation

Caltrans 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. FISH AND WILDLIFE COORDINATION ACT

The purpose of the Fish and Wildlife Coordination Act (FWCA) is to ensure that wildlife conservation receives equal consideration, and is coordinated with other aspects of water resources development (16 USC 661). The FWCA establishes a consultation requirement for Federal agencies that undertake any action to modify any stream or other body of water for any purpose, including navigation and drainage (16 USC 662(a)), regarding the impacts of their actions on fish and wildlife, and measures to mitigate those impacts. Consistent with this consultation requirement, NMFS provides recommendations and comments to Federal action agencies for the purpose of conserving fish and wildlife resources, and providing equal consideration for these resources. NMFS' recommendations are provided to conserve wildlife resources by preventing loss of and damage to such resources. The FWCA allows the opportunity to provide recommendations for the conservation of all species and habitats within NMFS' authority, not just those currently managed under the ESA and MSA.

The following recommendations apply to the proposed action:

- Caltrans should post interpretive signs within the action area describing the presence of listed fish and/or critical habitat as well as highlighting their ecological and cultural value.

The Action Agency must give these recommendations equal consideration with the other aspects of the proposed action so as to meet the purpose of the FWCA.

This concludes the FWCA portion of this consultation.

5. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

5.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion is Caltrans. Other interested users could include the City of Roseville Public Works Department, Placer County, U.S. Coast Guard, U.S. Fish and Wildlife Service, and California Department of Fish and Wildlife. Individual copies of this opinion were provided to Caltrans. This opinion 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.

5.2 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.

5.3 Objectivity

Information Product Category: Natural Resource Plan

Standards: This consultation and supporting documents are clear, concise, complete, and unbiased; and were developed using commonly accepted scientific research methods. They adhere to published standards including the NMFS ESA Consultation Handbook, ESA regulations, 50 CFR 402.01 et seq., and the MSA implementing regulations regarding EFH, 50 CFR 600.

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

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

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

6. REFERENCES

Anderson, N. H. and J. R. Sedell. 1979. Detritus Processing by Macroinvertebrates in Stream Ecosystems. Annual Review of Entomology 24(1):351-377.

California Department of Fish and Game. 1989. Inter-Departmental Memorandum. California Department of Water Resources.

California Department of Water Resources. 2002. Miners Ravine Habitat Assessment. State of California Department of Water Resources. Resource Restoration and Project Support Branch.

Cohen, S. J., K. A. Miller, A. F. Hamlet, and W. Avis. 2000. Climate Change and Resource Management in the Columbia River Basin. Water International 25(2):253-272.

Dettinger, M. D. and D. R. Cayan 1995. Large-Scale Atmospheric Forcing of Recent Trends toward Early Snowmelt Runoff in California. Journal of Climate 8(3): 606-623.

Dosskey, M. G., P. Vidon, N. P. Gurwick, C. J. Allan, T. P. Duval, and R. Lowrance. 2010. The Role of Riparian Vegetation in Protecting and Improving Chemical Water Quality in Streams. Wiley Online Library.

Flossi, Gary, Scott Downe, James Hopelain, Michael Bird, Robert Coey, and Barry Collins. California Salmonid Stream Habitat Restoration Manual.1998. Third Edition. California Department of Fish and Game.

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.

McClure, M. 2011. Climate Change in Status Review Update for Pacific Salmon and Steelhead Listed under the ESA: Pacific Northwest., M. J. Ford, editor, NMFS-NWFCS-113, 281 p.

McClure, M. M., M. Alexander, D. Borggaard, D. Boughton, L. Crozier, R. Griffis, J. C. Jorgensen, S. T. Lindley, J. Nye, M. J. Rowland, E. E. Seney, A. Snover, C. Toole, and V. A. N. H. K. 2013. Incorporating Climate Science in Applications of the U.S. Endangered Species Act for Aquatic Species. Conservation Biology 27(6):1222-1233.

Merz, J. E. and L. K. O. Chan. 2005. Effects of Gravel Augmentation on Macroinvertebrate Assemblages in a Regulated California River. River Research and Applications 21(1):61-74.

Moyle, Peter B. 2002. Inland Fishes of California. University of California Press.

National Research Council. 1996. Restoration of aquatic ecosystems. National Academy Press. Washington, DC.

Nilsson, C. and Dynesius M. 1994. Ecological Effects of River Regulation on Mammals and Birds: A Review. Regulated Rivers: Research and Management 9:45-53.

PFMC. 2014. Appendix A to the Pacific Coast Salmon Fishery Management Plan, as modified by Amendment 18. Identification and description of essential fish habitat, adverse impacts, and recommended conservation measures for salmon.

Pusey, B. J. and A. H. Arthington. 2003. Importance of the Riparian Zone to the Conservation and Management of Freshwater Fish: A Review. Marine and Freshwater Research 54(1):1-16

Reiser, D.J., and T.C. Bjornn. 1979. Influence of Forest and Rangeland Management on Anadromous Fish Habitat in Western North America; Habitat Requirements of Anadromous Salmonids. General Technical Report PNW-96. U.S.D.A. Forest Service, Pacific Northwest Forest and Range Experiment Station.

Schlosser, I. J. and J. R. Karr. 1981. Riparian Vegetation and Channel Morphology Impact on Spatial Patterns of Water Quality in Agricultural Watersheds. Environmental Management 5(3):233-243.

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. Bjornn, and F. H. Everest. 1984. Effects of Chronic Turbidity on Density and Growth of Steelheads and Coho Salmon. Transactions of the American Fisheries Society 113(2):142-150.

Swanson, Mitchell L. 1992. The Miners Ravine Creek Watershed Enhancement and Restoration Plan for the Reduction of Flood Hazards and the Enhancement and Protection of Environmental Resources. Mitchell Swanson and Associates.

Vanicek, D. 1993. Fisheries Habitat Evaluation, Dry Creek, Antelope Creek, Secret Ravine, and Miners Ravine. Prepared for EIP Associates.

Wade, A. A., T. J. Beechie, E. Fleishman, N. J. Mantua, H. Wu, J. S. Kimball, D. M. Stoms, and J. A. Stanford. 2013. Steelhead Vulnerability to Climate Change in the Pacific Northwest. Journal of Applied Ecology 50:1093-1104.

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

Williams, J. G. 2006. "Central Valley Salmon: A Perspective on Chinook and Steelhead in the Central Valley of California." San Francisco Estuary and Watershed Science 4(3): 416.