UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

December 23, 2020 **Refer to NMFS No:** WCRO-2020-02273

Karen Holmes
Senior Environmental Planner
California Department of Transportation
50 Higuera Street
San Luis Obispo, California 93401-5415

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the San Lorenzo River Bridge and Kings Creek Bridge Replacement (05-1H470)

Dear Ms. Holmes:

Thank you for the California Department of Transportation's (Caltrans)[1] letter on August 17, 2020, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the San Lorenzo River Bridge and Kings Creek Bridge Replacement (05-1H470). This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016). 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 (16 U.S.C. 1855(b)) for this action.

The enclosed biological opinion is based on our review of Caltrans' proposed project and describes NMFS' analysis of potential effects on threatened Central California Coast (CCC) steelhead, Central California Coast (CCC) coho salmon, and designated critical habitat for these species in accordance with section 7 of the ESA. In the enclosed biological opinion, NMFS concludes the project is not likely to jeopardize the continued existence of these species; nor is it likely to adversely modify critical habitat. However, NMFS anticipates that take of CCC steelhead and CCC coho salmon may occur. An incidental take statement which applies to this project with non-discretionary terms and conditions is included with the enclosed opinion.

[1]Pursuant to 23 USC 327, and through a series of Memorandum of Understandings beginning June 7, 2007, the Federal Highway Administration (FHWA) assigned and Caltrans assumed responsibility for compliance with Section 7 of the federal Endangered Species Act (ESA) and the Magnuson-Stevens Fishery Conservation and Management Act (MSA) for federally-funded highway projects in California. Therefore, Caltrans is considered the federal action agency for consultations with NMFS for federally funded projects involving FHWA. Caltrans proposes to administer federal funds for the implementation of the proposed project. Thus, per the aforementioned MOU, Caltrans is considered the federal action agency for this project.

NMFS has reviewed the proposed project for potential effects on EFH and determined that the proposed project would adversely affect EFH for Pacific Coast Salmon, which are managed under the Pacific Coast Salmon Fishery Management Plan. While the proposed action will result in adverse effects to EFH, the proposed project contains measures to minimize, mitigate, or otherwise offset the adverse effects; thus, no EFH Conservation Recommendations are included in this opinion.

If you have any questions concerning this consultation, or if you require additional information, please contact Elena Meza, North Central Coast Office in Santa Rosa, California at 707-575-6068 or via email at elena.meza@noaa.gov.

Sincerely,

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Enclosure

cc: Stephanie Herbert, Assoc. Environmental Planner, Caltrans, Stephanie.herbert@dot.ca.gov
Copy to E-File: ARN 151422WCR2020SR00173

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

San Lorenzo River Bridge and Kings Creek Bridge Replacement

NMFS Consultation Number: WCRO-2020-02273
Action Agency: California Department of Transportation (Caltrans)

Table 1. Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Central California Coast Coho Salmon (*Oncorhynchus kisutch*)	Endangered	Yes	No	Yes	No
Central California Coast steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	Yes	No

Table 2. Essential Fish Habitat and NMFS' Determinations:

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	No

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

Issued By:

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Date: December 23, 2020

TABLE OF CONTENTS

1. INTRODUCTION

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

1.1. Background

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

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

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the NOAA Library Institutional Repository. A complete record of this consultation is on file at NMFS' North-Central Coast Office in Santa Rosa, California.

1.2. Consultation History

On August 18, 2020, we received an initiation package from Caltrans requesting formal consultation for their project. Caltrans' request included a Biological Assessment, preliminary project plans, and D.W. Alley & Associates' (DWAA) 2018 steelhead report. Caltrans provided additional information to us on September 3, 2020, regarding the existing and proposed bridge dimensions, implementation of a debris containment system, clarification that sacked concrete removal will occur above the ordinary high water mark, and that 60% bridge design plans will be sent to us for review approximately five months prior to construction. On September 4, 2020, we notified Caltrans via email that there was sufficient information to initiate consultation, and that their consultation initiation date is August 18, 2020.

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). Under MSA, 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).

The project proposes to replace two bridges within Santa Cruz County, California on State Route (SR) 9, the San Lorenzo River Bridge[2] (No. 36-0052) at PM 13.6 and the Kings Creek Bridge[3] (No. 36-0054) at PM 15.5. The purpose of the project is to replace deteriorating infrastructure

[2] 37.132981/-122.125339
[3] 37.156378/-122.133703

that poses a threat to public safety. Both of the proposed new bridges will be constructed on the same alignment as the existing bridges.

1.3.1. San Lorenzo River Bridge Replacement

The existing San Lorenzo River Bridge is a steel stringer bridge with three spans. It is approximately 106 feet long and 30 feet wide (0.074 acres), and consists of two 12-foot lanes and two 3.25-feet curbs with wooden rails. The proposed new bridge will be a free span structure approximately 106 feet long and 40 feet wide (0.098 acres). The bridge will be equipped with standard 12-foot lanes, 8-foot shoulders, and a standard Midwest guardrail system (MGS). To avoid full closure of SR-9, one of the existing lanes will remain open while the other lane is demolished and removed. Because the existing abutments were constructed by casting materials directly into the exposed bedrock within the stream channel, the abutments will be partially removed in an effort to minimize removal of bedrock and alteration of the stream channel.[4] Following demolition, an alternate crash cushion will be installed on the southeast side of the bridge at the southern end of the MGS, and a buried post end anchor will be installed southwest of the bridge at the end of the MGS. Because the bridge is wider than the approaching road, tapers on each side of the bridge will be paved from the 8-foot bridge shoulder to the existing roadway shoulder. A retaining wall approximately 80 feet long will be built near the northeast corner of the bridge. Thirty-six cast-in-drilled-hole (CIDH) piles will support the new bridge. The piles are each 24 inches in diameter, will be installed to a depth of 70 feet, and approximately 10 feet above the OHWM. To prevent construction debris and contaminants from entering into the riverbed, a debris catchment system will be used and may be constructed out of wood, netting, steel, and plastic sheeting. Following construction of the new lane, traffic will be shifted and the remaining portion of the existing bridge will be demolished, removed, and the final bridge elements will be constructed. As part of the project, Caltrans will submit 60% bridge design plans to the Santa Rosa Caltrans Liaison for review at least five months prior to construction so NMFS can confirm the effects of the final project design are the same as the effects we associated with the preliminary design (30%), which are the basis of this consultation.

Staging and access is proposed in the northwest and southeast corners of the bridge. Staging will primarily occur within Caltrans' existing right-of-way due to limited space surrounding the bridge, private residences, and steep slopes. Temporary access roads will be constructed to provide access under, and near, the bridge and will require removal of four trees and additional vegetation in the first year of construction. Following completion of the project, all temporary construction areas (including access roads) will be revegetated.[5]

Access to the creek bed is needed to remove the existing bridge and construct the new bridge, and while instream construction work will be conducted during the dry season when flows are at

[4] Abutments will be removed to the extent required to make space for the new bridge abutments, and therefore will not be removed to original grade. Future design plans are anticipated to provide greater detail on existing abutment removal.

[5] While not known at this time, it is expected that specific replanting ratios (e.g. 3:1) will be required as part of the anticipated permit requirements associated with a 1602 streambed alteration agreement, and 404 and 401 permits.

annual lows (June 1 – October 15), a creek diversion will be necessary. To gain access, water will be temporarily diverted around the work area using a series of pipes, sized appropriately to the flow of water, and cofferdams up- and downstream of the area to be dewatered.[6] A maximum of 82 linear feet of the San Lorenzo River will be diverted to complete the project. As a result of maintaining an open lane throughout construction to avoid a full closure of SR 9, overall project construction may take a maximum of three construction seasons to complete; thus, Caltrans anticipates that a maximum of three dewatering events may occur. CCC coho salmon and CCC steelhead, if present in the work area, will be collected and relocated prior to dewatering the work site. The project will result in 0.024 acres of permanent impacts to the river channel resulting from the increased width of the new bridge structure.

Typical equipment used to complete the project is expected to include the following: pavers and rollers, backhoes, bidwell and roller screeds, bobcats, bulldozers/loaders, compressors, concrete pumps and truck mixers, cranes, dump trucks, excavators, pick-up trucks, front-end loaders, forklifts, graders, compactors, saw cutters, water trucks, and drill rigs.

Caltrans proposes to include several avoidance and minimization measures (AMMs) that will be implemented before, during, and after construction to prevent and minimize project-related effects to CCC coho salmon and CCC steelhead, and their critical habitat. These measures include working within the in-water work window of June 1 – October 15; ensuring proper handling and relocation of listed salmonids species during dewatering/diverting activities; ensuring establishment of revegetation areas; preventing introduction of contaminants into waterways; use of a debris containment system; ensuring complete removal and proper disposal of all construction waste; implementing erosion control measures; development of a fish handling and relocation plan, stormwater pollution prevention plan, a habitat restoration and revegetation plan, and a spill prevention control and countermeasure plan. For a full list of AMMs and additional best management practices (BMPs) please see Caltrans' Biological Assessment (2020).

1.3.2. Kings Creek Bridge Replacement

The existing Kings Creek Bridge is a concrete tee beam style-bridge with two spans. It is approximately 88 feet long and 28 feet wide (0.057 acres), and consists of two 10.6-foot lanes with a 4.5-foot wide curb along the northbound lane. The existing bridge is partially supported by a pier (0.0005 acres) located below the OHWM within Kings Creek. The proposed new bridge will be a free span structure approximately 99 feet long and 40 feet wide (0.085 acres), with standard 12-foot lanes, 8-foot shoulders, and standard MGS. To avoid full closure of SR 9, one of the existing lanes will remain open while the other is demolished and removed. Because the existing abutments were constructed by casting materials directly into the exposed bedrock within the stream channel, existing abutments will be partially removed in an effort to minimize removal of bedrock and alteration of the stream channel. Similarly, a portion of existing sacked concrete (0.049 acres), located approximately 10 feet above OHWM, along the existing northern

[6] The ultimate design and materials used to create the dewatering/diversion system will be at the discretion of the contractor.

abutment, will be removed and replaced with rock slope protection (RSP). The existing pier located below the OHWM will be removed to approximately three feet below original grade. On each side of the bridge, a taper will be paved from the 8-foot bridge shoulder to the existing roadway shoulder. Alternate crash cushions will be placed at the southeast and southwest ends of the MGS. Northeast of the bridge, a buried-post end anchor will be installed at the end of the MGS. A retaining wall with a concrete barrier is proposed for both southwest and southeast of the proposed new bridge with approximate lengths of 120 feet and 35 feet, respectively. Thirty-six cast-in-drilled-hole (CIDH) piles will support the new bridge. The piles are each 24 inches in diameter, will be installed to a depth of 70 feet deep, and will be approximately 12-15 feet above the OHWM. To prevent construction debris and contaminants from entering into the riverbed, a debris catchment system will be used and may be constructed out of wood, netting, steel, and plastic sheeting. Following construction of the new lane, traffic will be shifted and the remaining portion of the existing bridge will be demolished, removed, and the final bridge elements constructed. As part of the project, Caltrans will submit 60% bridge design plans to the Santa Rosa Caltrans Liaison for review at least five months prior to construction so NMFS can confirm the effects of the final project design are the same as the effects we associated with the preliminary design (30%), which are the basis of this consultation.

Staging and access is proposed in the area southeast and northwest of the bridge. Staging will primarily occur within Caltrans' existing right-of-way due to limited space surrounding the bridge, private residences, and steep slopes. Temporary access roads will be constructed to provide access under and near the bridge and will require removal of one tree and some additional vegetation in the first year of construction. Following completion of the project, all temporary construction areas (including access roads) will be revegetated.[7]

Access to the creek bed is needed to remove the existing bridge and construct the new bridge, and while instream construction work will be conducted during the dry season when flows are at annual lows (June 1 – October 15), a creek diversion will be necessary. To gain access, water will be temporarily diverted around the work area using a series of pipes, sized appropriately to the flow of water, and cofferdams up-and downstream of the area to be dewatered.[8] A maximum of 79 linear feet of the Kings Creek will be diverted to complete the project. As a result of maintaining an open lane throughout construction to avoid a full closure of SR 9, overall project construction may take a maximum of three construction seasons to complete; thus, Caltrans anticipates that a maximum of three dewatering events may occur. CCC steelhead and CCC coho salmon, if present in the work area, will be collected and relocated prior to dewatering the work site. The project will result in 0.028 acres of permanent impacts to the river channel resulting from the increased width of the new bridge structure.

Typical equipment used to complete the project is expected to include the following: pavers and rollers, backhoes, bidwell and roller screeds, bobcats, bulldozers/loaders, compressors, concrete

[7] While not known at this time, it is expected that specific replanting ratios (e.g. 3:1) will be required as part of the anticipated permit requirements associated with a 1602 streambed alteration agreement, and 404 and 401 permits.
[8] The ultimate design and materials used to create the dewatering/diversion system will be at the discretion of the contractor.

pumps and truck mixers, cranes, dump trucks, excavators, pick-up trucks, front-end loaders, forklifts, graders, compactors, saw cutters, water trucks, and drill rigs.

Caltrans proposes to include several AMMs that will be implemented before, during, and after construction to prevent and minimize project-related effects to CCC coho salmon and CCC steelhead, and their critical habitat. These measures include working within the in-water work window of June 1 – October 15; ensuring proper handling and relocation of listed salmonids species during dewatering/diverting activities; ensuring establishment of revegetation areas; preventing introduction of contaminants into waterways; use of a debris containment system; ensuring complete removal and proper disposal of all construction waste; implementing erosion control measures; development of a fish handling and relocation plan, stormwater pollution prevention plan, a habitat restoration and revegetation plan, and a spill prevention control and countermeasure plan. For a full list of AMMs and additional BMPs please see Caltrans' Biological Assessment (2020).

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

The ESA establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat upon which they depend. As required by section 7(a)(2) of the ESA, each Federal agency must ensure that its actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide 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 biological opinion includes both a jeopardy analysis and an adverse modification analysis. The jeopardy analysis relies upon the regulatory definition of "jeopardize the continued existence of" a listed species, which is "to engage in an action that reasonably 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 biological 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 as a whole for the conservation of a listed species" (50 CFR 402.02).

The designations of critical habitat for species uses the term primary constituent element (PCE) or essential features. The 2016 critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The 2019 regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the regulations (84 FR 44977), that definition does not change the scope of our analysis and in this opinion we use the terms "effects" and "consequences" interchangeably.

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

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their habitat using an exposure-response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly 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, or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2. Rangewide 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' "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 conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species.

2.2.1. Species Description and Life History

The biological opinion analyses the effects of the federal action on the following federally listed species (Distinct Population Segment [DPS] or Evolutionary Significant Unit [ESU]) and designated critical habitat:

Endangered Central California Coast (CCC) coho salmon ESU (*Oncorhynchus kisutch*)
Endangered (70 FR 37160; June 28, 2005)
Critical habitat (64 FR 24049; May 5, 1999);

Threatened Central California Coast (CCC) steelhead DPS (*Oncorhynchus mykiss*)
Threatened (71 FR 834, January 5, 2006)
Critical habitat (70 FR 52488, September 2, 2005).

The CCC steelhead DPS includes steelhead in coastal California streams from the Russian River to Aptos Creek, and the drainages of Suisun, San Pablo, and San Francisco bays (72 FR 5248). The CCC coho salmon ESU includes coho from Punta Gorda in northern California south to, and including, Aptos Creek in central California, as well as populations in tributaries to San Francisco Bay, excluding the Sacramento-San Joaquin River System (61 FR 56138).

The action area is within designated critical habitat for CCC steelhead and CCC coho salmon. CCC steelhead critical habitat is designated from the Russian River to the San Lorenzo River to a lateral extent of ordinary high water in freshwater stream reaches, and to extreme high water in estuarine areas. CCC coho salmon critical habitat is designated to include all river reaches assessable to listed coho salmon from Punta Gorda in northern California south to the San Lorenzo River in central California, and includes Arroyo Corte Madera Del Presidio and Corte Madera Creek, tributaries to San Francisco Bay. Critical habitat consists of the water, substrate, and adjacent riparian zone of estuarine and riverine reaches (including off-channel habitats).

2.2.1.1. General Steelhead Life History

Steelhead are the anadromous form of *O. mykiss*, spawning in freshwater and migrating to marine environments to grow and mature. Steelhead have a complex life history that requires successful transition between life stages across a range of freshwater and marine habitats (i.e., egg-to-fry emergence, juvenile rearing, smolt outmigration, ocean survival, and upstream migration and spawning). Steelhead exhibit a high degree of life history plasticity (Shapovalov and Taft 1954; Thrower et al. 2004; Satterthwaite et al. 2009; Hayes et al. 2012). The occurrence and timing of these transitions are highly variable and generally driven by environmental conditions and resource availability (Satterthwaite et al. 2009; Sogard et al. 2012).

Steelhead are generally divided into two ecotypes based on timing and state of maturity when returning to freshwater: summer-run and winter-run. Summer-run steelhead return to natal streams in spring and early summer while they are still sexually immature and spend several months maturing before spawning in January and February (Nielson and Fountain 2006). Winter-run steelhead enter natal streams as mature adults with well-developed gonads. They typically immigrate between December and April and spawn shortly after reaching spawning

grounds (Shapovalov and Taft 1954; Moyle et al. 2008). Winter-run steelhead are the most common ecotype and are the only ecotypes expressed in the CCC steelhead DPS.

Adult steelhead spawn in gravel substrates with low sedimentation and suitable flow velocities. Females lay eggs in redds, where they are quickly fertilized by males and covered. Egg survival depends on oxygenated water circulating through the gravel, facilitating gas exchange and waste removal. Adults usually select spawning sites in pool-riffle transition areas of streams with gravel cobble substrates between 0.6 to 10.2 centimeters (cm) in diameter and flow velocities between 40-91 cm per second (Smith 1973; Bjornn and Reiser 1991). Eggs incubate in redds for approximately 25 to 35 days depending on water temperature (Shapovalov and Taft 1954). Incubation time depends on water temperature, with warmer temperatures leading to lower incubation periods due to increased metabolic rates. Eggs hatch as alevin and remain buried in redds for an additional two to three weeks until yolk-sac absorption is complete (Shapovalov and Taft 1954). Optimal conditions for embryonic development include water temperatures between 6 and 10°C, dissolved oxygen near saturation, and fine sediments less than 5% of substrate by volume (Bjornn and Reiser 1991; USEPA 2001).

Upon emerging from redds, juvenile steelhead occupy edgewater habitats where flow velocity is lower and cover aids in predator avoidance. Rearing juveniles feed on a variety of aquatic and terrestrial invertebrates. As they grow, juveniles move into deeper pool and riffle habitats where they continue to feed on invertebrates and have been observed feeding on younger juveniles (Chapman and Bjornn 1969; Everest and Chapman 1972). Juveniles can spend up to four years rearing in freshwater before migrating to the ocean as smolts, although they typically only spend one to two years in natal streams (Shapovalov and Taft 1954; Busby et al. 1996; Moyle 2002). Successful rearing depends on stream temperatures, flow velocities, and habitat availability. Preferred water temperature ranges from 12 to 19°C and sustained temperatures above 25°C are generally considered lethal (Smith and Li 1983; Busby et al. 1996; Moyle 2002; McCarthy et al. 2009). In Central California streams, juvenile steelhead are able to survive peak daily stream temperatures above 25°C for short periods when food is abundant (Smith and Li 1983). Response to stream temperatures can vary depending on the conditions to which individuals are acclimated, however, consistent exposure to high stream temperatures results in slower growth due to elevated metabolic rates and lower survival rates overall (Hokanson et al. 1977; Busby et al. 1996; Moyle 2002; McCarthy et al. 2009).

Juveniles undergo behavioral, morphological, and physiological changes in preparation for ocean entry, collectively called smoltification. Juveniles begin smoltification in freshwater and the process continues throughout downstream migration with some smolts using estuaries for further acclimation to saltwater prior to ocean entry (Smith 1990; Hayes et al. 2008). Juveniles typically will not smolt until reaching a minimum size of 160 mm (Burgner et al. 1992). Smoltification is cued by increasing photoperiod. Stream temperatures influence the rate of smoltification, with warmer temperatures leading to more rapid transition. Downstream migration of smolts typically occurs from April to June when temperature and stream flows increase. Preferred temperature for smoltification and outmigration is between 10 and 17°C with temperatures below 15°C considered optimal (Hokanson et al. 1977; Wurtsbaugh and Davis 1977; Zedonis and Newcomb

1997; Moyle 2002; Myrick and Cech 2005). In coastal systems with seasonal lagoons, smolts may take advantage of higher growth potential in productive lagoon habitats before ocean entry (Osterback et al. 2018).

Adult steelhead are known to be highly migratory during ocean residency but little is known of their habitat use and movements. They have been observed moving north and south along the continental shelf, presumably to areas of high productivity to feed (Barnhart 1986). Adults will typically spend one to two years in the ocean, feeding and growing in preparation for spawning (Shapovalov and Taft 1954; Busby et al. 1996). Upstream migration typically begins once winter rains commence and stream flows increase. For coastal systems with seasonal freshwater lagoons, winter storms are required to breech the sandbars and allow access to upstream spawning sites. Within the action area, steelhead migrate through large, permanently open bays; CCC steelhead migrate through San Francisco Bay and Monterey Bay, respectively. Unlike most congenerics, steelhead are iteroparous, meaning they can return to spawn multiple times. Adult steelhead may spawn up to four times in their lifetime, although spawning runs predominantly consist of first-time spawners (~59%) (Shapovalov and Taft 1954). The maximum life span of steelhead is estimated to be nine years (Moyle 2002).

2.2.1.2. General Coho Salmon Life History

The life history of the coho salmon in California has been well documented (Shapovalov and Taft 1954; Hassler 1987; Weitkamp et al. 1995). In contrast to the life history patterns of other anadromous salmonids, coho salmon in California generally exhibit a relatively simple three year life cycle. Adult salmon typically begin the immigration from the ocean to their natal streams after heavy late-fall or winter rains breach the sand bars at the mouths of coastal streams (Sandercock 1991). Coho salmon are typically associated with small to moderately-sized coastal streams characterized by heavily forested watersheds; perennially-flowing reaches of cool, high quality water; dense riparian canopy; deep pools with abundant overhead cover; instream cover consisting of large, stable woody debris and undercut banks; and gravel or cobble substrates (Sandercock 1991). Immigration continues into March, generally peaking in December and January, with spawning occurring shortly after arrival at the spawning ground (Shapovalov and Taft 1954).

When in freshwater, optimal habitats for successful coho include adequate quantities of: (1) deep complex pools formed by large woody debris; (2) adequate quantities of water; (3) cool water temperatures [when maximum weekly average water temperatures exceed 18°C Coho salmon are absent from otherwise suitable rearing habitat (Welsh et al. 2001); temperatures between 12-14° C are preferred; and the upper lethal limit is between 25-26°C.]; (4) unimpeded passage to spawning grounds (adults) and back to the ocean (smolts); (5) adequate quantities of clean spawning gravel; and (6) access to floodplains, side channels and low velocity habitat during high flow events. Numerous other requirements exist (*i.e.*, adequate quantities of food, dissolved oxygen, low turbidity, *etc.*), but in many respects these other needs are generally met when the six freshwater habitat requirements listed above are at a properly functioning condition.

The eggs generally hatch after four to eight weeks, depending on water temperature. Survival and development rates depend, in part, on fine sediment levels within the redd. Under optimum conditions, mortality during this period can be as low as 10 percent; under adverse conditions of high scouring flows or heavy siltation, mortality may be close to 100 percent (Baker and Reynolds 1986). McMahon (1983) found that egg and fry survival drops sharply when fines make up 15 percent or more of the substrate. The newly-hatched fry remain in the redd from two to seven weeks before emerging from the gravel (Shapovalov and Taft 1954). Upon emergence, fry seek out shallow water, usually along stream margins. As they grow, juvenile coho salmon often occupy habitat at the heads of pools, which generally provide an optimum mix of high food availability and good cover with low swimming cost (Nielsen 1992). In the spring, as yearlings, juvenile coho salmon undergo a physiological process, or smoltification, which prepares them for living in the marine environment. Emigration timing is correlated with precipitation events and peak upwelling currents along the coast. Entry into the ocean at this time facilitates more growth and, therefore, greater marine survival (Holtby et al. 1990).

2.2.2. Status of the Listed Species

NMFS assesses four population viability[9] parameters to discern the status of the listed ESUs and DPSs and to assess each species ability to survive and recover. These population viability parameters are: abundance, population growth rate, spatial structure, and diversity (McElhany et al. 2000). While there is insufficient data to evaluate these population viability parameters quantitatively, NMFS has used existing information to determine the general condition of the populations in the CCC steelhead DPS, the CCC coho salmon ESU, and factors responsible for the current status of these listed species.

The population viability parameters are used as surrogates for numbers, reproduction, and distribution, as defined in the regulatory definition of jeopardy (50 CFR 402.20). For example, abundance, population growth rate, and distribution are surrogates for numbers, reproduction, and distribution, respectively. The fourth parameter, diversity, is related to all three regulatory criteria. Numbers, reproduction, and distribution are all affected when genetic or life history variability is lost or constrained, resulting in reduced population resilience to environmental variation at local or landscape-level scales.

2.2.2.1. CCC Steelhead DPS

Historically, approximately 70 populations of steelhead existed in the CCC steelhead DPS (Spence et al. 2008; Spence et al. 2012). Approximately 37 of these populations were independent, or potentially independent, meaning they had a high likelihood of surviving for 100 years absent anthropogenic impacts (Bjorkstedt et al. 2005). The remaining populations were dependent upon immigration from nearby CCC steelhead DPS populations to ensure their viability (McElhaney et al. 2000; Bjorkstedt et al. 2005).

[9] NMFS defines a viable salmonid population as "an independent population of any Pacific salmonid (genus *Oncorhynchus*) that has a negligible risk of extinction due to threats from demographic variation, local environmental variation, and genetic diversity changes over a 100- year time frame" (McElhany et al. 2000).

Abundance data for CCC steelhead are limited; however, existing information indicates population abundances have been substantially reduced from historical levels. In the mid-1960's, a total of 94,000 adult steelhead were estimated to spawn in CCC steelhead rivers, including 50,000 fish in the Russian River, the largest population in the DPS (Busby et al. 1996). Abundance estimates for smaller coastal streams in the DPS indicate low but stable levels with recent estimates for several streams (Lagunitas, Waddell, Scott, San Vicente, Pudding, and Caspar creeks) at individual run sizes of 500 fish or less (62 FR 43937). Some loss of genetic diversity has been documented and attributed to previous among-basin transfers of stock and local hatchery production in interior populations in the Russian River (Bjorkstedt et al. 2005). In San Francisco Bay streams, reduced population sizes and habitat fragmentation has likely also led to loss of genetic diversity in these populations. For more detailed information on trends in CCC steelhead abundance, see: Busby et al. 1996; Good et al. 2005; Spence et al. 2008; Williams et al. 2011; and Williams et al. 2016.

CCC steelhead have experienced serious declines in abundance and long-term population trends suggest a negative growth rate, indicating the DPS may not be viable in the long-term. DPS populations that historically provided enough steelhead immigrants to support dependent populations may no longer be able to do so, thereby putting dependent populations at increased risk of extirpation. Recent status reviews and return data indicate an ongoing potential for the DPS to become endangered in the future (Good et al. 2005). In 2006, NMFS issued a final determination that the CCC steelhead DPS is a threatened species, as previously listed (71 FR 834). A CCC steelhead viability assessment completed in 2008 concluded that populations in watersheds that drain to San Francisco Bay are highly unlikely to be viable, and that the limited information available did not indicate that any other CCC steelhead populations could be demonstrated to be viable (Spence et al. 2008).

In the Santa Cruz Mountains, the California Coastal Monitoring Program (CMP) has been recently initiated for CCC steelhead. New information from three years of the CMP indicates that population sizes there are perhaps higher than previously thought. However, the long-term downward trend in the Scott Creek population, which has the most robust estimates of abundance, is a source of concern. Although steelhead occur in the Russian River, the ratio of hatchery fish to natural origin fish remains a concern. The viability of San Francisco Bay watershed populations remains highly uncertain. Population-level estimates of adult abundance are not available for any of the seven independent populations inhabiting the watersheds of the coastal strata (Novato Creek, Corte Madera Creek, Guadalupe River, Saratoga Creek, Stevens Creek, San Francisquito Creek, and San Mateo Creek). The scarcity of information on CCC steelhead abundance continues to make it difficult to assess whether conditions have changed appreciably since the previous status review assessment of Williams et al. (2011). On May 26, 2016, NMFS chose to maintain the threatened status of the CCC steelhead (81 FR 33468).

2.2.2.2. CCC Coho Salmon ESU

Historically, the CCC coho salmon ESU was comprised of approximately 76 coho salmon populations. Most of these were dependent populations that needed immigration from other

nearby populations to ensure their long-term survival. Historically, there were 11 functionally independent populations and 1 potentially independent population of CCC coho salmon (Spence et al. 2008, Spence et al. 2012). Most of the populations in the CCC coho salmon ESU are currently doing poorly as a result of low abundance, range constriction, fragmentation, and loss of genetic diversity, as described below.

Brown et al. (1994) estimated that annual spawning numbers of coho salmon in California ranged between 200,000 and 500,000 fish in the 1940s, which declined to 100,000 fish by the 1960s, followed by a further decline to 31,000 fish by 1991. More recent abundance estimates vary from approximately 600 to 5,500 adults (Good et al. 2005). Recent status reviews (Williams et al. 2011) indicate that the CCC coho salmon are likely continuing to decline in number. CCC coho salmon have also experienced acute range restriction and fragmentation. Adams et al. (1999) found that in the mid 1990's coho salmon were present in 51 percent (98 of 191) of the streams where they were historically present, and documented an additional 23 streams within the CCC coho salmon ESU in which coho salmon were found for which there were no historical records. Recent genetic research has documented reduced genetic diversity within subpopulations of the CCC coho salmon ESU (Bjorkstedt et al. 2005). The influence of hatchery fish on wild stocks has likely also contributed to the lack of diversity through outbreeding depression and disease.

Available data from the few remaining independent populations suggests population abundance continues to decline, and many independent populations that in the past supported the species overall numbers and geographic distributions have been extirpated. This suggests that populations that historically provided support to dependent populations via immigration have not been able to provide enough immigrants for many dependent populations for several decades. The near-term (10 - 20 years) viability of many of the extant independent CCC coho salmon populations is of serious concern. These populations may not have enough fish to survive additional natural and human caused environmental change.

The two conservation hatchery programs are the Don Clausen Coho Salmon Conservation Program on the Russian River in Sonoma County, California, and the smaller Kingfisher Flat Hatchery on Scott Creek, Santa Cruz County, California. While differing in size and funding, both programs were initiated in 2001 in response to severely depressed coho salmon abundances. Fish are collected from the wild, brought into the hatcheries, genetically tested, and spawned to maximize diversity and prevent inbreeding. In the hatchery, fish are raised to various ages, fed krill, tagged, and released into streams throughout the watersheds. This release strategy allows the fish to imprint on the creek with the aim that they will return to these streams as adults so they can spawn naturally. Juvenile coho salmon and coho salmon smolts have been released into several Russian River tributaries and coastal watersheds in San Mateo and Santa Cruz counties.

None of the five diversity strata defined by Bjorkstedt et al. (2005) currently support viable coho salmon populations. According to Williams et al. (2016), recent surveys suggest CCC coho abundance has improved slightly since 2011 within several independent populations (mainly north of SF bay), although all populations remain well below their high-risk dispensation

thresholds identified by Spence et al. (2008). The Russian River and Lagunitas Creek populations are relative strongholds for the species compared to other CCC ESU populations, the former predominantly due to out-planting of hatchery-reared juvenile fish from the Russian River Coho Salmon Broodstock Program. The most recent status review (NMFS 2016) documents conditions for CCC coho salmon have not improved since the last status review in 2011 (Williams et al. 2016. The overall risk of CCC coho salmon extinction remains high, and the most recent status review reaffirmed the ESU's endangered status (NMFS 2016). NMFS's recovery plan (NMFS 2012) for the CCC coho salmon ESU identified the major threats to population recovery. These major threats include roads, water diversions and impoundments, and residential development.

2.2.3. Status of CCC Steelhead and CCC Coho Salmon Critical Habitat

In designating critical habitat, NMFS considers the following requirements of the species: 1) space for individual and population growth and for normal behavior; 2) food, water, air, light, minerals, or other nutritional or physiological requirements; 3) cover or shelter; 4) sites for spawning, reproduction, and rearing offspring; and, generally 5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of the species (50 CFR 424.12(b)). In addition to these factors, NMFS also focuses on PBFs and/or essential habitat types within the designated area that are essential to the conservation or protection of the species (81 FR 7414).

PBFs for CCC steelhead critical habitat and their associated essential features within freshwater include:

1. freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation, and larval development;
2. freshwater rearing sites with:
    a) water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;
    b) water quality and forage supporting juvenile development; and
    c) natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;
3. freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

PBFs for CCC steelhead critical habitat, and their associated essential features within estuarine areas include: areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and

boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

For CCC coho salmon critical habitat, the following essential habitat types were identified: 1) juvenile summer and winter rearing areas; 2) juvenile migration corridors; 3) areas for growth and development to adulthood; 4) adult migration corridors; and 5) spawning areas. PBFs for coho salmon include adequate (64 FR 24049): (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions (64 FR 24049).

The condition of CCC steelhead, and CCC coho salmon critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined that currently depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat[10]: logging, urban and agricultural land development, mining, stream channelization, and bank stabilization, dams, wetland loss, and water withdrawals (including unscreened diversions for irrigation). Habitat impacts of concern include altered streambank and channel morphology, elevated water temperature, lost spawning and rearing habitat, habitat fragmentation, impaired gravel and wood recruitment from upstream sources, degraded water quality/quantity, lost riparian vegetation, and increased sediment delivery into streams from upland erosion (Weitkamp *et al*. 1995; Busby et al. 1996; 64 FR 24049; 70 FR 37160; 70 FR 52488). Based on NMFS familiarity with the landscapes in which these critical habitats occur, these impacts continue to persist today. Widespread diverting of rivers and streams, as well as the pumping of groundwater hydraulically connected to stream flow, has dramatically altered the natural hydrologic cycle in many of the streams within the CCC steelhead DPSs, and CCC coho ESU which can delay or preclude migration and dewater aquatic habitat. Stream channelization, commonly caused by streambank hardening and stabilization, represents a very high threat to instream and floodplain habitat throughout much of the designated critical habitat for both species, as detailed within the CCC coho salmon and CCC steelhead recovery plans (NMFS 2012 and 2016, respectively). Streambank stabilization confines stream channels and precludes natural channel movement, resulting in increased streambed incision, reduced habitat volume and complexity. Overall, the current condition of CCC steelhead and CCC salmon critical habitat is degraded, and does not provide the full extent of conservation value necessary for the recovery of the species.

The CZU Lightening Complex started as a series of lightening fires on August 16, 2020 across western Santa Cruz and San Mateo counties (California Department of Forestry and Fire Protection and California Department of Conservation 2020). The fire was fully contained on September 22, 2020; a total of 86,509 acres burned. Portions of the burned area represented some of the highest quality habitat for salmonids south of San Francisco (Casagrande pers com. 2020). The long-term impacts on such valuable salmonid habitat are yet to be determined. However,

[10] Other factors, such as over fishing and artificial propagation have also contributed to the current population status of these species. All these human induced factors have exacerbated the adverse effects of natural environmental variability from such factors as drought and poor ocean productivity.

there is heightened concern related to increased sediment run-off and erosion, decreased riparian vegetation, increased stream temperatures, and decreased water quality. There has not been significant rainfall in the burned areas since these fires, nor detailed habitat inventories, but it is likely CCC steelhead and CCC coho salmon spawning, rearing, and migratory habitat was directly impacted by the fires, and may be affected by future rain events.

2.2.4. Additional Threats to CCC steelhead and CCC coho salmon Critical Habitat

Another factor affecting the rangewide status of CCC coho salmon and steelhead, and aquatic habitat at large, is climate change. Global climate change presents an additional potential threat to salmonids and their critical habitats. Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level have all increased in California over the last century (Kadir et al. 2013). Snow melt from the Sierra Nevada has declined (Kadir et al. 2013). However, total annual precipitation amounts have shown no discernable change (Kadir et al. 2013). Listed salmonids may have already experienced some detrimental impacts from climate change. NMFS believes the impacts on listed salmonids to date are likely fairly minor because natural, and local, climate factors likely still drive most of the climatic conditions salmonids experience, and many of these factors have much less influence on salmonid abundance and distribution than human disturbance across the landscape.

The threat to salmonids from global climate change will increase in the future. Modeling of climate change impacts in California suggests that average summer air temperatures are expected to continue to increase (Lindley et al. 2007, Moser et al. 2012). Heat waves are expected to occur more often, and heat wave temperatures are likely to be higher (Hayhoe et al. 2004, Moser et al. 2012, Kadir et al. 2013). Total precipitation in California may decline; critically dry years may increase (Lindley et al. 2007, Schneider 2007, Moser et al. 2012). Wildfires are expected to increase in frequency and magnitude (Westerling et al. 2011, Moser et al. 2012).

For Northern California, most models project heavier and warmer precipitation. Extreme wet and dry periods are projected, increasing the risk of both flooding and droughts (California Department of Water Resources 2013). Estimates show that snowmelt contribution to runoff in the Sacramento/San Joaquin Delta may decrease by about 20 percent per decade over the next century (Cloern et al. 2011). Many of these changes are likely to further degrade CCC coho salmon and steelhead habitat by, for example, reducing streamflows during the summer and raising summer water temperatures. Estuaries may also experience changes detrimental to salmonids. Estuarine productivity is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia et al. 2002, Ruggiero et al. 2010). In marine environments, ecosystems and habitats important to juvenile and adult salmonids are likely to experience changes in temperatures, circulation, water chemistry, and food supplies (Brewer and Barry 2008, Feely 2004, Osgood 2008, Turley 2008, Abdul-Aziz et al. 2011, Doney et al. 2012). The projections described above are for the mid to late 21st Century. In shorter time frames, climate conditions not caused by the human addition of carbon dioxide to the atmosphere are more likely to predominate (Cox and Stephenson 2007, Santer et al. 2011).

2.3. Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area includes two locations within the San Lorenzo River watershed in Santa Cruz County, California that are approximately two river miles away from each other. Kings Creek enters the San Lorenzo River approximately 350 feet downstream of the Kings Creek Bridge location. The action area includes areas that may be affected by stream diversion, fish capture and relocation, and construction activities; including the riverbed, banks, riparian corridor, and adjacent storage areas above top of bank adjacent to the river channel.

2.3.1. San Lorenzo River Bridge Replacement

The action area includes a maximum of 82 linear feet of the San Lorenzo River that will be dewatered for construction purposes, and approximately 100 feet of the San Lorenzo River channel immediately downstream of the dewatered area where temporary construction effects may occur.

2.3.2. Kings Creek Bridge Replacement

The action area includes a maximum of 79 linear feet of the Kings Creek that will be dewatered for construction purposes, and approximately 100 feet of Kings Creek channel immediately downstream of the dewatered area where temporary construction effects may occur.

2.4. Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. 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 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

The San Lorenzo River is the largest coastal watershed in Santa Cruz County, encompassing approximately 138 square miles. About 62 percent of the San Lorenzo River watershed is coniferous forest and about 22 percent of the watershed area is either shrub or grasslands; the remaining 16 percent is urban development. The climate is Mediterranean, with over 90 percent of annual precipitation occurring between November and April. Major land uses in the upper watershed are forest, open land, logging, recreation, agriculture, rural residential, while the lower watershed is more urbanized (e.g., City of Santa Cruz) and supports residential development, and tourism (NMFS 2016). Flow from the San Lorenzo River watershed, along with groundwater resources, provides up to 80 percent of the water supply for the city of Santa Cruz system and is a key supply for the communities of the San Lorenzo Valley.

2.4.1. Status of Listed CCC Steelhead and CCC Coho Salmon in the Action Area

Results from long-term fisheries surveys conducted within the San Lorenzo watershed (County of Santa Cruz 2018; DWAA 2006, 2007, 2008, 2015) provide good information (as described below) for inferring the status of CCC steelhead and CCC coho salmon within the action area, and inform the following assessment of the status of CCC steelhead and CCC coho salmon within the action area.

2.4.1.1. CCC Steelhead in the Action Area

The San Lorenzo River steelhead population is considered a very important population within the watershed and DPS (NMFS 2016). The San Lorenzo River is the largest watershed is the Santa Cruz Mountains Diversity Stratum (NMFS 2016).[11] This population is functionally independent and likely provides frequent dispersal to nearby smaller coastal populations (NMFS 2016a). Recovery criteria for the CCC steelhead San Lorenzo River population is a spawner density target of 3,200 (as described in NMFS 2016).

CCC steelhead are present in most of Santa Cruz County's streams that are accessible from the ocean, including the San Lorenzo River and Kings Creek. The County of Santa Cruz is a partner of the Juvenile Salmonid and Stream Habitat Monitoring (JSSHM) program that collects data on juvenile salmonid densities within Santa Cruz County, including the San Lorenzo River. One of the long-term collection sites is located approximately 0.3 miles south of the San Lorenzo River Bridge at the confluence of the San Lorenzo River and Bear Creek (DWAA 2019, [Figure 1]). Electrofishing surveys at this long-term site from 1981, 1994-2001, 2003-2005, and 2014-2018 yielded densities that ranged between 0.70 and 69.70 fish per 100 feet of creek, with an average density of 25.96 fish per 100 feet (County of Santa Cruz 2018).

Data from an additional long-term collection site within the JSSHM program exists approximately 350 feet south of Kings Creek Bridge, located at the confluence of Kings Creek and the San Lorenzo River (DWAA 2018, [Figure 1]). Electrofishing surveys at this long-term site from 1981, 1994-2001, 2003-2005, and 2013-2018 yielded densities that ranged between 2.1 and 126.80 fish per 100 feet of creek, with an average density of 33.43 fish per 100 feet (County of Santa Cruz 2018).

Given the regular presence of steelhead within the action area, CCC steelhead are expected to occur in the action area year round. With the proposed in-water work window of June 1 to October 15, juvenile CCC steelhead are expected to be present within the action area during the proposed summer work window.

[11] The Central California Coast (CCC) steelhead Distinct Population Segment (DPS) consists of five Diversity Strata with 38 independent populations of winter-run steelhead (12 functionally independent and 26 potentially independent) and 22 dependent populations. The delineation of the CCC steelhead DPS Diversity Strata was based on environmental and ecological similarities and life history. Five strata were identified as North Coastal, Interior, Santa Cruz Mountains, Coastal San Francisco Bay, and Interior San Francisco Bay (for more information, see NMFS 2016).

2.4.1.2. CCC Coho Salmon in the Action Area

Historically, coho salmon were believed to inhabit all or most of the accessible coastal streams in Santa Cruz County. By the 1960's coho salmon were believed present in seven stream systems in Santa Cruz County including the San Lorenzo River System (Bryant 1994). Aptos Creek is the southern boundary of the CCC ESU. While small numbers of wild *O. kisutch* have been observed in the trap at the Felton Diversion Dam in recent years (e.g., one adult coho in the 2012/2013 trapping year), juvenile coho salmon were last captured at two electrofishing sites on Bean Creek in 2005; that same year, two juvenile coho salmon were captured in Zayante Creek near the confluence with Bean Creek (Hagar 2005) and observed in Bean Creek during snorkel surveys conducted by NMFS staff (DWAA 2019). CCC coho salmon have not been observed in the middle mainstem San Lorenzo River since salmonid monitoring by DWAA began in 1994 (DWAA 2019), and the population is at an extreme risk of extirpation (NMFS 2012).

Based on the apparent absence of the CCC coho salmon from the middle mainstem of the San Lorenzo River, the species has an exceedingly low likelihood of occurrence in both portions of the action area at the time of project construction. With the proposed in-water work window of June 1 to October 15, only juvenile CCC coho would be expected to be present within the action area during the proposed summer work window, if they are present at all.

2.4.2. Status of Critical Habitat in the Action Area

The action area is designated critical habitat for CCC steelhead and CCC coho salmon, and supports spawning, rearing, and migration of these listed species. Essential features include substrate, water quality, water quantity, water temperature, water velocity, cover/shelter, food, riparian vegetation, space, and safe passage conditions. The principle factors responsible for current steelhead and salmon habitat conditions in the action area are described below and are organized by the major factors responsible for current habitat conditions: water diversions, sedimentation, loss of riparian vegetation and large woody debris from streams, and climate change. While the action area comprises a very small portion of the San Lorenzo River Watershed, these factors have likely reduced available spawning and rearing habitat for steelhead and coho salmon in the action area.

Designated critical habitat within the action area is moderately degraded from a properly functioning condition. Water diversions and resulting decreases in stream flow are a limiting factor for fisheries in the action area (NMFS 2012). Depletion and diversion of natural flows have altered natural hydrological cycles, and subsequent flows, in most streams inhabited by CCC steelhead and CCC coho salmon in Santa Cruz County. Reduction of flows negatively affect salmonid habitat by loss of usable habitats due to dewatering and blockage, stranding of fish resulting from rapid flow fluctuations; migration delays, entrainment of juveniles into unscreened or poorly screened diversions, and increased lethal and sublethal effects resulting from increased water temperatures (Bergren and Filardo 1993, Chapman and Bjornn 1968). Reduced flows degrade or diminish fish habitats via increased deposition of fine sediments in spawning gravels, decreased recruitment of new spawning gravels, and encroachment of riparian and non-endemic vegetation into spawning and rearing areas.

As described in the CCC steelhead and CCC coho salmon recovery plans, road densities are high throughout the San Lorenzo River watershed (NMFS 2016; NMFS 2012). Road densities are estimated at 5.3 miles of road per square mile of watershed area, and at 6.2 miles per square mile of riparian area. Roads were determined as a primary sediment source, including private, public, and timber harvest roads. The periodic grading and leveling of unsurfaced roads continuously expose erodible material both on the road surface and along the road shoulders. This loose, unconsolidated material is frequently mobilized during winter storms when it enters the water column. Many of these roads have areas that fail recurrently at the same unstable locations. These reoccurring bank failures contribute to ongoing instream sedimentation and often are addressed by bank hardening. Stabilization of banks along road corridors, without reestablishment of riparian vegetation, furthered additional bank instability and increased rates of sediment input.

Aquatic habitats in the San Lorenzo River watershed, including the action area, have deteriorated considerably from historical conditions (Santa Cruz Planning Department 1979) due to increased rates of sediment input into the river. The high rates of sediment input have impaired salmonid spawning, feeding, and rearing habitats by burying spawning gravels, disrupting invertebrate (salmonid food) production, and filling in pools needed by salmonids for thermal and predator refuge. Elevated rates of fine sediment input are considered by many fisheries experts to be the primary limiting factor to salmonid production in the San Lorenzo River watershed, including portions of the action area (DWAA 2004).

Other impacts of roads include changes and losses to riparian vegetation and structure that lead to ongoing impacts to water quality. Many of the streams in the County have reduced riparian complexity, and most have gaps in the riparian corridor. Santa Cruz County had been conducting logjam removal at the request of streamside property owners starting in the 1970s.[12] The purpose of cutting up large woody material in the past was to prevent or reduce potential flooding and bank erosion to adjoining property owners. Lasserette (2003) indicates the majority of large woody debris (LWD) in the County has accumulated in connection with infrastructure such as bridges, culverts, and road crossings because many were designed and constructed without consideration of passing large wood. Few remaining watersheds in the County, including the San Lorenzo, retain the appropriate levels of large wood to sustain various life stages of salmonids (NMFS 2012). Riparian vegetation clearing has not been limited to County operations; private landowners have cleared riparian vegetation with or without County approval.

Modifications to riparian corridors have reduced salmonid carrying capacity. Wood in and over streams creates cover from predators, and large woody debris often results in the localized scour of deep pools that provide salmonids thermal refuge and hiding places from predators (Dolloff 1983). The loss of riparian vegetation removes cover for fish over streams, and reduces the amount of wood that enters stream channels from tree death, wind-throw, and bank erosion. The result is a reduction in a stream's carrying capacity for juvenile fish, particularly coho salmon (Glova 1978). In the CCC coho salmon ESU, watersheds that have increased agricultural and/or

[12] Santa Cruz Board of Directors Flood Control and Water Conservation District Resolution NO. 417-71.

urban development also have depressed populations of coho salmon (NMFS 2010 and 2012) in large part due to the removal or reduction of large wood elements in stream channels and floodplains. The river flows through the action area in highly confined valleys with steep bedrock slopes, and the right bank within the Kings Creek portion of the action area is armored with sacked concrete. Tree species in the area are coast redwood, red alder, sycamore, tanoak, and coast redwood trees. Additional vegetation is a mix of non-native, invasive Himalayan blackberry, English ivy, and thimbleberry. Overall, vegetation within the action are is sparse, to lacking, due to the aforementioned banks; although a healthy canopy of trees exists above the OHWM. Both reaches of the river are comprised of deep pools, cobble substrate, and fine sediments that likely result from the surrounding steep bedrock slopes.

The long-term effects of climate change have been presented above, and include temperature and precipitation changes that may affect steelhead, coho salmon, and critical habitat by changing water quality, streamflow levels, and salmonid migration in the action area. The threat to salmonids in in the action area from climate change is likely going to mirror what is expected for the rest of Central California. NMFS expects that average summer air temperatures in the action area would continue to increase, heat waves would become more extreme, and droughts and wildfire would occur more often (Lindley et al. 2007, Hayhoe et al. 2004, Moser et al. 2012; Kadir et al. 2013, Schneider 2007, Westerling et al. 2011). Many of these changes are likely to further degrade CCC steelhead and CCC coho salmon critical habitat throughout the action area by, for example, reducing streamflow during the summer and raising summer water temperatures.

As noted above, the CZU Lightening Complex burned 86,509 acres. The action area lies just east of the fire's perimeter (California Department of Forestry and Fire Protection and California Department of Conservation 2020 [Figure 3]), and therefore did not experience direct impacts to critical habitat (i.e. loss of soil cover, vegetation and canopy, soil heating, etc.). However, there is potential for critical habitat within the San Lorenzo River watershed, including the action area, to be indirectly impacted by post-fire debris flows guided eastward as a result of surrounding topography and geology (California Department of Forestry and Fire Protection and California Department of Conservation 2020). There has not been significant rainfall on the San Lorenzo watershed since these fires, and so the current exposure of listed salmonids in the action area to the effects of these fires is likely negligible. With a significant rain event, debris flows may occur and could impact critical habitat through increased sedimentation, contaminants, and pollutants, and/or removal of riparian vegetation.

2.4.3. Previous Section 7 Consultations and Section 10(a)(1)(A) Permits in the Action Area

Although no previous individual section 7 consultation with NMFS have occurred within the action area of the projects, NMFS has completed programmatic consultations for salmonid habitat restoration actions that include the action area of this project. These programmatic consultations include the NOAA Restoration Center's restoration program, the Corps' Regional General Permit #12 programmatic consultation, and the Santa Cruz Countywide Partners in Restoration Permit Coordination Program (Program). These consultations anticipate a limited

amount of take for juvenile salmonids during instream work conducted in the summer months. NMFS determined these restoration actions are likely to improve habitat conditions for listed species and that the limited amount of take anticipated is unlikely to affect future adult returns.

In addition to the above, NMFS also conducted a programmatic consultation, the Large Woody Material Management Program in Santa Cruz County, where the proposed suite of activities was likely to adversely affect ESA-listed fish species or critical habitat, which resulted in a programmatic biological opinion.

NMFS' Section 10(a)(1)(A) research and enhancement permits and section 4(d) limits or exceptions could potentially occur in any of the watersheds covered under this Program, including the reaches within the action area. Salmonid monitoring approved under these programs includes carcass surveys, smolt outmigration trapping, and juvenile density surveys. In general, these activities are closely monitored and require measures to minimize take during the research activities. NMFS determined these research projects are unlikely to affect future adult returns.

2.5. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b).

In this biological opinion, our approach to determine the effects of the action was based on institutional knowledge and a review of the ecological literature and other relevant materials. We used this information to gauge the likely effects of the proposed suite of projects using an exposure and response framework that focuses on the stressors (physical, chemical, or biological), directly or indirectly caused by the proposed action, to which CCC steelhead and CCC coho salmon are likely to be exposed. Next, we evaluate the likely response of the above listed fish to these stressors in terms of changes to survival, growth, and reproduction, and changes to the ability of PBFs to support the value of critical habitat in the action area. PBFs include sites essential to support one or more life stages of the species. These sites for migration, spawning, and rearing, in turn, contain physical and biological features that are essential to the conservation of the species. Where data to quantitatively determine the effects of the proposed action on listed fish and their critical habitat were limited or not available, our assessment of effects focused mostly on qualitative identification of likely stressors and responses.

Construction activities, both during and post-project completion, associated with the proposed project may affect CCC steelhead, CCC coho salmon, and their designated critical habitat. The following may result from construction activities: unintentional direct injury or mortality during fish collection, relocation, and dewatering activities; temporary loss of benthic habitat;

reductions in riparian vegetation and cover; temporary increases in suspended sediments; and temporary and minor increases in hazardous materials and contaminants from heavy machinery and construction materials.

2.5.1. Fish Collection and Relocation

To facilitate the completion of the project, portions of the San Lorenzo River and Kings Creek will need to be dewatered. As discussed above, a maximum amount of 82 and 79 linear feet will be dewatered, respectively. The project proposes to collect and relocate fish in the work area prior to, and during dewatering to avoid fish stranding and exposure to construction activities. Before and during dewatering of the construction site, juvenile salmonids will be captured by a qualified biologists using one of more of the following methods: dip net, seine, thrown net, block net, minnow trap, and electrofishing. Collected salmonids will be relocated to an appropriate stream reach that will minimize impacts to captured fish, and to fish that are already residing at the release site. Since construction is scheduled to occur between June 1 and October 15, relocation activities will occur during the summer low-flow period after emigrating smolts have left and before adults have immigrated for spawning. Only juvenile salmonids are expected to be in the action area during the construction period. Therefore, NMFS expects capture and relocation of listed salmonid species will be limited to pre-smolting and young-of-the-year juveniles.

Fish collection and relocation activities pose a risk of injury or mortality to rearing juvenile salmonids. Any fish collecting gear, whether passive (Hubert 1996) or active (Hayes et al. 1996) has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of unintentional injury and mortality attributable to fish capture varies widely, depending on the method used, the ambient conditions, and the expertise and experience of the field crew. Since fish relocation activities will be conducted by qualified fisheries biologists following NMFS electrofishing guidelines (NMFS 2000), injury and mortality of juvenile salmonids during capture and relocation will be minimized. Based on prior experience with current relocation techniques and protocols likely to be used to conduct the fish relocation, unintentional mortality of listed juvenile salmonids expected from capture and handling procedures is not likely to exceed 2 percent.

Relocated fish may also have to compete with other fish causing increased competition for available resources such as food and habitat. To reduce the potential for competition, fish relocation sites will be pre-approved by NMFS to ensure the sites have adequate habitat to allow for survival of transported fish and fish already present. Nonetheless, crowding could occur which would likely result in increased inter- and intraspecific competition at those sites. Responses to crowding by salmonids include self-thinning, resulting in emigration and reduced salmonid abundance with increased individual body size within the group, and/or increased competition (Keeley 2003). Relocation sites will be selected to ensure they have similar water temperatures as the capture sites, and adequate habitat to allow for survival of transported fish and fish already present. However, some of the fish released at the relocation sites may choose not to remain in these areas and move either upstream or downstream to areas that have more

vacant habitat and a lower density of fish. As each fish moves, competition remains either localized to a small area or quickly diminishes as fish disperse. In some instances, relocated fish may endure some short-term stress from crowding at the relocation sites. Such stress is not likely to be sufficient to reduce their individual fitness or performance. NMFS cannot accurately estimate the number of fish likely to be exposed to competition, but does not expect this short-term stress to reduce the individual performance of juvenile salmonids, or cascade through the watershed population of these species. Fish that avoid capture during relocation may be exposed to risks described in the following section on dewatering (see Section 2.5.2 below).

To estimate the number of juvenile steelhead that may be present in the San Lorenzo River portion of the action area, we used data described in Section 2.4.1.1 above from surveys performed by the County of Santa Cruz and DWAA within the San Lorenzo River watershed. Using the 16-year average of the density data described above, 25.96 juvenile steelhead can be expected to be encountered in a dewatered reach of 100 linear feet. Using this data, and the proposed dewatered length of 82 linear feet, NMFS estimates that no more than 22 juvenile steelhead will be present in the dewatered area when relocation and dewatering activities occur during each construction each year.[13] Considering environmental variability such as interannual variation in temperature, variations in predator or prey abundance, habitat conditions in the action area, and other factors, NMFS assumes that as many as 25 percent more juvenile steelhead may be present in the area to be dewatered each year. The 25 percent increase is based on NMFS' best professional judgement as to the likely variability in steelhead density during the three years needed to complete the project. If 25 percent more than 22 juvenile CCC steelhead are present, this would result in 28 juvenile CCC steelhead present in the 82-foot-dewatered area during each dewatering event.[14] Considering the proposed maximum of three dewatering events that might be necessary to complete the work, this would result in 84 juvenile CCC steelhead present in the dewatered area over the term of the project.[15]

To estimate the number of juvenile steelhead that may be present in the Kings Creek portion of the action area, we used data described in Section 2.4.1.1 above from surveys performed by the County of Santa Cruz and DWAA within the San Lorenzo River watershed. Using the 17-year average of the density data described above, 33.43 juvenile steelhead are expected to be encountered in a dewatered reach of 100 linear feet. Using this data, and the proposed dewatered length of 79 linear feet, NMFS estimates that no more than 27 juvenile CCC steelhead will be present in the dewatered area when relocation and dewatering activities occur during construction each year.[16] Considering environmental variability such as interannual variation in temperature, variations in predator or prey abundance, habitat conditions in the action area, and

[13] (25.96 juvenile steelhead*82 linear feet dewatered)/100 linear feet = 21.29 juvenile steelhead/100 linear feet, or 22 juvenile steelhead/100 linear feet when rounding up.
[14] ((22 juvenile steelhead/100 linear feet*0.25) + 22 juvenile steelhead) = 27.50 juvenile steelhead/100 linear feet, or 28 juvenile steelhead/100 linear feet when rounding up.
[15] 28 juvenile steelhead/100 linear feet*3 dewatering events = 84 juvenile steelhead/100 linear feet.
[16] (33.43 juvenile steelhead*79 linear feet dewatered)/100 linear feet = 26.41 juvenile steelhead/100 linear feet, or 27 juvenile steelhead/100 linear feet when rounding up.

other factors, NMFS assumes that as many as 25 percent more juvenile CCC steelhead may be present in the area to be dewatered each year. The 25 percent increase is based on NMFS' best professional judgement as to the likely variability in CCC steelhead density during the three years needed to complete dewatering. If 25 percent more than 27 juvenile steelhead are present, this would result in 34 juvenile CCC juvenile steelhead present in the 79-foot-dewatered area during each dewatering event.[17] Considering the proposed maximum of three dewatering events that might be necessary to complete the work, this would result in 102 juvenile CCC steelhead present in the dewatered area over the term of the project.[18]

As described in Section 2.4.1.2, CCC coho salmon have an exceedingly low likelihood of occurrence in the action area at the time of project construction. Based on the limited data that exists within the San Lorenzo River watershed, NMFS estimates that no more than five juvenile CCC coho salmon will be present in each of the dewatered areas of the San Lorenzo River and Kings Creek during each construction year. Considering the proposed maximum of three dewatering events that might be necessary to complete the work, this would result in 15 juvenile CCC coho salmon present in the dewatered area over the life of the project.

Applying applicable AMMs to fish collection, relocation, and dewatering activities is expected to appreciably reduce the effects of project actions on juvenile salmonids. Specifically, salmonid collection and relocation activities conducted by NMFS-approved fisheries biologists will ensure proper equipment operation and application of NMFS guidelines thereby minimizing injury and mortality to juvenile salmonids. Restricting the work window to June 1 to October 15 will limit the effects to stream rearing juvenile salmonids. NMFS expects applying AMMs will effectively minimize injury and mortality to juvenile CCC steelhead and CCC coho in the action area.

2.5.2. Dewatering

As described above, completion of the project will require dewatering of Kings Creek and the San Lorenzo River. Cofferdams and a series of pipes will be used to temporarily divert flows around each work site during construction. Dewatering of the channel is estimated to affect up to 79 linear feet of Kings Creek and 82 linear feet of the San Lorenzo River. NMFS anticipates temporary changes to instream flow within, and downstream, of each project site during installation of the diversion systems, and during dewatering operations. Once installation of the diversion systems are complete, stream flow above and below the work sites should be the same as free-flowing pre-project conditions, except within the dewatered reaches where stream flow is bypassed. These fluctuations in flow are anticipated to be small, gradual, and short-term, but are expected to cause a temporary loss, alteration, and reduction of aquatic habitat, and, in the case of areas that will be dewatered, will likely result in mortality of any salmonids that avoid capture during fish relocation activities.

Stream flow diversion and dewatering at both project sites could harm individual rearing juvenile salmonids by concentrating or stranding them in residual wetted areas before they are relocated.

[17] ((27 juvenile steelhead/100 linear feet*0.25) + 27 juvenile steelhead) = 33.75 juvenile steelhead/100 linear feet, or 34 juvenile steelhead/100 linear feet when rounding up.
[18] 34 juvenile steelhead/100 linear feet*3 dewatering events = 102 juvenile steelhead/100 linear feet.

Juvenile salmonids that avoid capture in the project work areas will likely die during dewatering activities due to desiccation, thermal stress, or be crushed by equipment or foot traffic if not found by biologists while water levels within the reaches recede. Because the pre-dewatering fish relocation efforts at both project sites will be performed by qualified biologists, NMFS expects that the number of juvenile salmonids that will be killed as a result of stranding during dewatering activities will be very small, likely no more than one percent of the salmonids within the work sites prior to dewatering.

Dewatering operations at both project sites may affect benthic (bottom dwelling) aquatic macroinvertebrates, an important food source for salmonids. Benthic aquatic macroinvertebrates at each project site may be killed or their abundance reduced when river habitat is dewatered (Cushman 1985). However, effects to aquatic macroinvertebrates resulting from both stream flow diversions and dewatering activities will be temporary because construction activities will be short lived, and the dewatered reaches will not exceed 79 linear feet in Kings Creek and 82 linear feet in San Lorenzo Creek. Rapid recolonization (typically one to two months) of disturbed areas by macroinvertebrates is expected following rewatering (Cushman 1985, Thomas 1985, Harvey 1986). In addition, the effect of macroinvertebrate loss on juvenile salmonids in likely to be negligible because food from upstream sources (via drift) would be available downstream of the dewatered areas since stream flow, if present, will be bypassed around the project work site. Based on the foregoing, juvenile salmonids are not anticipated to be exposed to a reduction in food sources at either project site from the minor and temporary reduction in aquatic macroinvertebrates as a result of dewatering activities.

Beyond the dewatered area, the temporary stream diversion at each project site is expected to resemble typical summer low conditions. The diversion systems could restrict movement of listed salmonid species in a manner similar to the normal seasonal isolation of pools by intermittent flow conditions that typically occur during summer within a portion of some streams through the range of CCC steelhead and CCC coho salmon. Because the quality of habitat in and around the action area is adequate to support rearing salmonids, NMFS expects salmonids will be able to find food and cover downstream of the action area as needed during dewatering activities.

2.5.3. Increased Sedimentation and Turbidity

The proposed project will result in disturbance of the streambed and banks for construction. Construction activities within the action area may result in disturbance of the dewatered streambed and banks for equipment access, construction activities, and placement/removal of stream diversion structures. Instream and near-stream construction activities have been shown to result in temporary increases in turbidity (reviewed in Furniss et al. 1991, Reeves et al. 1991, Spence et al. 1996). While the cofferdams and stream diversion systems are in place, construction activities are not expected to degrade water quality in Kings Creek or the San Lorenzo River because the work area will be dewatered and isolated from the flowing waters. Disturbed soils on the creek bank are easily mobilized when later fall and winter storms increase streamflow levels. Thus, NMFS anticipates disturbed soils could affect water quality and critical

habitat in the action area in the form of small, short-term increases in turbidity during re-watering (i.e., cofferdam removal), and subsequent higher flow events during the first winter storms post-construction.

Increases in sediment may affect fish by a variety of mechanisms. High concentrations of suspended sediment can disrupt normal feeding behavior and efficiency (Cordone and Kelley 1961, Bjornn et al. 1977, Berg and Northcote 1985), reduce growth rates (Crouse et al. 1981), and increase plasma cortisol levels (Servizi and Martens 1992). High turbidity concentrations can reduce dissolved oxygen in the water column, result in reduced respiratory functions, reduce tolerance to diseases, and cause fish mortality (Sigler et al. 1984, Berg and Northcote 1985, Gregory and Northcote 1993, Velagic 1995, Waters 1995). Even small pulses of turbid water will cause salmonids to disperse from established territories (Waters 1995), which can displace fish into less suitable habitat, and/or increase competition and predation, decreasing chances of survival. Increased sediment deposition can fill pools and reduce the amount of cover available to fish, decreasing the survival of juveniles (Alexander and Hansen 1986).

Chronic elevated sediment and turbidity levels may affect salmonids as described above. However, sedimentation and turbidity levels associated with cofferdam removal, rewetting of the construction sites within the action area, and subsequent rainfall events are not expected to rise to the levels described in the previous paragraph because the projects proposed soil and channel stabilization measures to prevent sediment mobilization. Additionally, Caltrans proposes AMMs and BMPs (associated with its stormwater pollution prevention plan) specifically aimed at reducing erosion, scour, and sedimentation in storage and staging areas, riparian areas, and from water diversions (Caltrans 2020). Therefore, any resulting elevated turbidity levels would be minor, occur for a short period, and be well below levels and durations shown in the scientific literature as causing injury or harm to salmonids (Sigler et al. 1984, Newcombe and Jensen 1996). NMFS expects any sediment or turbidity generated by the projects would not extend more than 100 feet downstream of the worksites, based on site conditions and methods used to control sedimentation and turbidity. Thus, NMFS does not anticipate harm, injury, or behavioral impacts to juvenile salmonids associated with exposure to the minor elevated suspended sediment levels that are expected to be generated by the projects.

2.5.4. Pollution from Hazardous Materials and Contaminants

Operating equipment in and near streams has the potential to introduce hazardous materials and contaminants into streams. Potentially hazardous materials include wet and dry concrete debris, fuels, and lubricants. Spills, discharges, and leaks of these materials can enter streams directly or via runoff. If introduced into streams, these materials could impair water quality by altering the pH, reducing oxygen concentrations as the debris decomposes, or by introducing toxic chemicals such as hydrocarbons or metals into aquatic habitat. Oil and similar substances from construction equipment can contain a wide variety of polynuclear hydrocarbons (PAHs) and metals. PAHs can alter salmonid egg hatching rates and reduce egg survival as well as harm the benthic organisms that are a salmonid food source (Eisler 2000). Disturbance of streambeds by heavy

equipment or construction activities can also cause the resuspension and mobilization of contaminated stream sediment with absorbed metals.

The equipment needed to complete the project has the potential to release debris, hydrocarbons, concrete, and similar contaminants into surface waters at both work sites. These effects have the potential to harm or injure exposed fish and temporarily degrade habitat. However, AMMs proposed at both work sites will substantially reduce or eliminate the potential for construction material and debris to enter waterways. Limiting the work window to the dry season from June 1 to October 15 will limit hazardous material exposure to juvenile salmonids, and eliminate potential for containments to adversely affect the most sensitive life stages (i.e. eggs, alevin, and fry). Equipment will be checked daily at both work sites to ensure proper operation and avoid any leaks or spills. Proper storage, treatment, and disposal of construction materials and discharge management is expected to substantially reduce or eliminate contaminants entering both waterways via runoff. Finally, the debris containment systems will eliminate containments from entering Kings Creek and the San Lorenzo River during construction activities. Due to these measures, conveyance of toxic materials into active waters at both work sites during project construction is not expected to occur, and the potential for the project to degrade water quality and adversely affect salmonids is improbable.

2.5.5. Removal of Riparian Vegetation and Habitat Loss

The project will result in permanent and prolonged temporary reductions in riparian vegetation, including tree removal, necessary for construction access and staging, and during removal of existing bridges at both work sites. Riparian vegetation helps maintain stream habitat conditions necessary for salmonid growth, survival, and reproduction. Riparian zones and wetland/aquatic vegetation serve important functions in stream ecosystems such as providing shade (Poole and Berman 2001), sediment storage and filtering (Cooper et al. 1987, Mitsch and Gosselink 2000), nutrient inputs (Murphy and Meehan 1991), water quality improvements (Mitsch and Gosselink 2000), channel and streambank stability (Platts 1991), source of woody debris that creates fish habitat diversity (Bryant 1983, Lisle 1986, Shirvell 1990), and both cover and shelter for fish (Bustard and Narver 1975, Wesche et al. 1987, Murphy and Meehan 1991). Riparian vegetation disturbance and removal can degrade these ecosystem functions and impair stream habitat. Removal of riparian vegetation increases stream exposure to solar radiation, leading to increases in stream temperatures (Poole and Berman 2001).

Complete removal of approximately four trees at the San Lorenzo River site and approximately one tree at the Kings Creek site, in addition to removal of other herbaceous vegetation, will likely result in both permanent and prolonged temporary reductions in shade and cover for fish. However, as part of Caltrans' proposed AMMs, trees will be trimmed, limbed, and root wads will be left in place in lieu of full removal, whenever possible, to prevent erosion and to reduce potential impacts of riparian vegetation removal on salmonids (Caltrans 2020). The shade lost from tree trimming, limbing, or removal will be offset by the increase in shaded areas provided by the new wider bridges (0.024 acres and 0.028 acres of new shaded area in San Lorenzo River and Kings Creek, respectively). The action area also has healthy canopy cover that will continue

to provide shade during construction of both bridges. The shade provided by the new bridges may also provide nominal benefits (i.e. cooler water temperatures) to salmonids within the action area.

Trimmed vegetation is expected to grow back, and trees and other native vegetation disturbed during construction will be replanted on-site (following the third year of construction) and monitored to ensure the success of revegetation efforts to restore areas impacted by removal of riparian vegetation. Therefore, other services provided by vegetation, such as sediment storage and filtering, nutrient inputs, sources of woody debris, and habitat complexity (i.e., cover) will remain degraded at the sites until new vegetation is replanted and becomes established. Because of the timing and establishment of the on-site revegetation, the temporary prolonged loss of cover may cause individual salmonids to seek alternative areas for cover and forage. Such temporary displacement of salmonids is not expected to reduce their individual performance because there are sites nearby that provide these features and can accommodate additional individuals without becoming overcrowded. Thus, impacts of reduced shade and other vegetative services (i.e. sediment storage and filtering, nutrient input, etc.) from removal of riparian vegetation are not expected to significantly change the behavior of individual salmonids with the action area.

2.5.6. Critical Habitat Effects

The action area is designated critical habitat for CCC steelhead and CCC coho salmon. Generally, PBFs of critical habitat for both steelhead and coho found within the action area include sites for migration, spawning, and rearing (see section 2.4.2). As discussed above, the construction activities are expected to result in disturbance to stream channels and adjacent streambanks which could result in impacts to critical habitat in the action area by diminishing PBFs.

Mobilization of sediment during construction and post-construction activities has the potential to result in high levels of turbidity and suspended sediment if appropriate AMMs are not implemented. Caltrans, however, is proposing AMMs that will isolate work sites from live streams and prevent pulses of sediment from entering streams after construction is complete. Some minor and temporary increases in turbidity and suspended sediment is expected to occur within the dewatered reaches and portion of streams downstream of the active work sites. Such increases are not expected to alter water quality, substrate conditions, or pool habitat to the extent that PBFs in the action area would be diminished.

Dewatering approximately 79 and 82 linear feet of Kings Creek and the San Lorenzo River, respectively, in the action area for up to 3.5 months during three dry seasons at each site will expose habitat in these areas to artificial and repetitive dry conditions. Salmonid forage at these sites will be reduced for up to two months following rewatering, after which, macroinvertebrate abundance is expected to return to pre-dewatering levels (Cushman 1985, Thomas 1985, Harvey 1986). Thus, forage supporting juvenile development will be diminished at each site for up to 5.5 months for up to three years. Furthermore, salmonid rearing habitat at each site will be reduced in area equal to the dewatered areas for up to 3.5 months for up to three dry seasons.

Critical habitat will also be impacted as a result of riparian vegetation removal within the action area. Impacts to freshwater rearing sites that provide shade, sediment storage and filtering, nutrient inputs, and habitat complexity will occur as a result of tree removal, trimming, and limbing, and removal of other herbaceous vegetation to complete construction at both work sites. Assuming complete removal of trees, we expect riparian vegetation attributes at both sites will return to pre-project levels within 10 years due to Caltrans' proposed AMMs, revegetation measures, and vegetation growth rates. Shade at the sites will be maintained despite reductions in vegetation because of the expansion of the bridges which is about equal to the riparian canopy reductions. However, during the construction and revegetation timeframe of 10 years, habitat at the sites will suffer reductions in vegetation associated cover and forage. These reductions will diminish the quality of salmonid freshwater rearing and adult forage sites, and migration corridors at each site during the 10 year construction and revegetation timeframe.

Finally, the proposed action may nominally improve freshwater spawning, rearing, and migration PBFs by removing 0.0005 acres of fill from the creekbed within the Kings Creek portion of the action area. Removal of this fill will provide a nominal amount of migratory and/or rearing habitat to salmonids that travel through the Kings Creek portion of the action area that has not been accessible since the construction of the Kings Creek Bridge.

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 and 402.17(a)). 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.

Residential land use and non-federal water diversions are expected to continue within the action area (NMFS 2012, NMFS 2016). Water diversion effects of reduced base flows within the action area are described in the Environmental Baseline section of this consultation. Diversions are not expected to change appreciably, and will continue to perpetuate into the future. Urban development, including rural residential and agricultural development is likely to continue throughout Santa Cruz County. NMFS assumes the rate of such development would be similar to that observed in the last decade.

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).

2.7. Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we

add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the cumulative effects (Section 2.6), taking into account the status of the species and critical habitat (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminish the value of designated or proposed critical habitat as a whole for the conservation of the species.

The action area for the project includes two sites in Santa Cruz County, California: one located in Kings Creek, a perennial tributary to the San Lorenzo River; and one in the San Lorenzo River. Threatened CCC steelhead and endangered CCC coho salmon and their critical habitat occur in the action area. CCC steelhead are listed as threatened and CCC coho salmon are listed as endangered. Based on the extensive loss of historic habitat due to dams, forestry practices, and urban and agricultural land development, and the degraded condition of remaining spawning and rearing habitats, CCC steelhead and CCC coho salmon have experienced severe declines.

As described in the CCC Coho Recovery Plan (NMFS 2012) and the Coastal Multi-Species Recovery Plan (NMFS 2016a), and discussed in Section 2.2 above, CCC steelhead and CCC coho salmon have declined to a large degree from historic numbers. CCC coho are depressed to the point that their population is highly fragmented. Soquel Creek lost its native run of coho salmon around 1968, and the population is dependent on returns of adult coho from other watersheds (NMFS 2012). Steelhead populations in the CCC steelhead DPS are the most poorly monitored salmonid populations in the North-Central California Coast Recovery Domain (NMFS 2016a). Sub-populations within the CCC steelhead DPS, including Soquel Creek, are generally healthier than CCC coho in the same watersheds; however, population trends for both species are declining. Therefore, survival and full recovery of both populations will be unlikely unless habitat conditions are widely improved.

As described in Section 2.5 Effects of the Action, NMFS identified the following components of the project that may result in effects to CCC steelhead, CCC coho, and/or habitat: fish collection and relocation, dewatering, temporary increases in suspended sediment and other construction-related contaminants, temporary loss of benthic habitat and reductions in riparian vegetation and cover. Of these, fish collection and relocation, and dewatering have the potential to result in injury and mortality of juvenile CCC steelhead and CCC coho.

The project proposes to dewater approximately 79 and 82 linear feet of the San Lorenzo River and Kings Creek, respectively, for up to 5.5 months for up to three years; construction is scheduled to occur during the dry season. Therefore, it is anticipated that only rearing juvenile salmonids will be present in the action area during construction, and no adult or smolt life stages of salmonids would be affected by the project activities. For the San Lorenzo River Bridge Replacement and the Kings Creek Bridge Replacement projects, NMFS estimates up to 28 and 34 juvenile CCC steelhead, respectively, and five juvenile coho salmon at each site, may be present in the reaches to be dewatered prior to construction each year.

Anticipated mortality from relocation is expected to be two percent (or less) of the fish relocated, and mortality expected from dewatering is expected to be one percent (or less) of the fish in the areas prior to dewatering (combined mortality not to exceed three percent). Therefore, NMFS expects no more than one juvenile steelhead would be injured or killed by fish relocation/ dewatering at each project site during each construction year. When considering the proposed maximum of three dewatering events that might be necessary to complete the work at each site, NMFS expects no more than six juvenile steelhead would be injured or killed by fish relocation/dewatering over the life of the project. Similarly, because no more than five juvenile coho salmon are expected to be present at both project sites, NMFS expects no more than one juvenile coho salmon would be injured or killed by fish relocation/dewatering each year of construction. When considering the proposed maximum of three dewatering events that might be necessary to complete the work at each site, NMFS expects no more than six juvenile coho salmon would be injured or killed by fish relocation/dewatering over the life of the project. Due to the relatively large number of juveniles produced by each spawning pair, steelhead and coho salmon spawning in the San Lorenzo River watershed in future years are likely to produce enough juveniles to replace the few that may be lost at the project sites due to relocation and dewatering. Thus, it is unlikely that the small potential loss of up to six juvenile steelhead, and six juvenile coho salmon during the life of the project will impact future adult returns.

In addition to the adverse effects described above, we also consider the potential impacts of increased sedimentation and turbidity, pollution from hazardous materials and contaminants, and removal of riparian vegetation and habitat loss. The implementation of proposed AMMs is expected to render the potential for fish to be exposed to pollution from hazardous materials and contaminants improbable. Similarly, increased sedimentation and turbidity, and removal of riparian vegetation and habitat loss are not expected to result in reductions in fitness of individual salmonids with the action area. NMFS does not expect any of the aforementioned effects to occur simultaneously with other effects in any significant way. Therefore, we do not expect the proposed project to affect the persistence or recovery of the San Lorenzo River population of steelhead or coho, or the CCC steelhead DPS or CCC coho ESU.

The cumulative impacts of non-federal future activities that are likely to occur in, or have affects in the action area were discussed in Section 2.6, and included a discussion of the future effects of water diversions. Diversions in the San Lorenzo River watershed are expected to perpetuate the reduced base flows in the watershed, and are identified as a threat to CCC steelhead and CCC coho salmon populations in the San Lorenzo River watershed.

Climate change could affect CCC steelhead and CCC coho in the action area. Although one anticipated outcome of future climate change is increases in water temperature brought on by increased summer air temperatures, NMFS anticipates these affects will be somewhat buffered by the steep valley walls and the existing healthy tree canopy. For short-term effects, climate change is not expected to significantly worsen existing conditions over the time frame considered in this biological opinion. Considering the above, we do not expect climate change to affect CCC steelhead or CCC coho salmon in the action area beyond the scope considered in this biological opinion.

The Kings Creek and San Lorenzo sites are critical habitat for the CCC steelhead DPS and CCC coho salmon ESU. In our adverse modification analysis, we consider the condition of critical habitat, the potential effects of the projects (completed and pending) on critical habitat, and whether or not those effects are expected to directly or indirectly diminish the value of critical habitat for the conservation of CCC steelhead or CCC coho salmon. We also consider the potential for climate change to alter conditions in the action area such that critical habitat may be affected over the duration of time we consider for this consultation. These elements (condition of critical habitat across the DPS/ESU, in the watershed, and in the action area; effects of the project on critical habitat, and effects of climate change on critical habitat) are considered further below.

Across the CCC steelhead DPS and CCC coho salmon ESU, critical habitat has been degraded by habitat alteration and development. While conditions vary throughout, critical habitat is generally impaired by habitat alteration and fragmentation, water diversions, groundwater extraction, and estuarine habitat loss. These factors also affect CCC steelhead and CCC coho salmon critical habitat in the San Lorenzo River and Kings Creek, which have both been impaired by urban and agricultural development, dam construction, and forestry practices. Both watershed-wide factors and action area-specific factors affect critical habitat in the action area leading to reduced habitat complexity and accessibility, poor substrate quality for spawning, and limited juvenile rearing habitat.

Effects to critical habitat from the proposed project are expected to include temporary impacts during construction activities and reduced riparian vegetation. During dewatering activities, forage supporting juvenile development will be diminished at each site for up to 5.5 months for up to three years; and salmonid rearing habitat at each site will be reduced in area equal to the dewatered areas for up to 3.5 months for up to three dry seasons. Critical habitat at the sites will also suffer reductions in vegetation associated cover and forage during the construction and revegetation timeframe of 10 years. These reductions will diminish the quality of salmonid freshwater rearing and adult forage sites, and migration corridors at each site during the 10 year construction and revegetation timeframe. In sum, the proposed action will degrade PBFs and essential habitat types in the action area. Yet, the effects will be temporary and make up a relatively small portion of CCC steelhead and CCC coho critical habitat in the San Lorenzo River watershed and the DPS/ESU. When added to the environmental baseline, cumulative effects, and species status, the effects to critical habitat from the proposed action are not expected to appreciably reduce the quality and function of critical habitat at the larger CCC steelhead DPS or CCC coho ESU.

Regarding future climate change effects in the action area, California could be subject to higher average summer air temperatures and lower total precipitation levels. Reductions in the amount of snowfall and rainfall would reduce streamflow levels in Northern and Central Coastal Rivers. For these projects, in-water activities would occur on a relatively short-term basis, even when considering the three-year project life; thus, the above effects of climate change are not likely to be detected within that period. If the effects of climate change are detected over the short term, they will likely materialize as moderate changes to the current climate conditions within the

action area. These changes may place further stress on CCC steelhead and CCC coho salmon populations. The effects of the proposed action combined with moderate climate change effects may result in conditions similar to those produced by natural ocean-atmospheric variations described in the Environmental Baseline section of this opinion, and annual variations. CCC steelhead and CCC coho salmon are expected to persist throughout these phenomena, as they have in the past, even when concurrently exposed to the effects of similar projects.

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, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence CCC steelhead, nor destroy or adversely modify its designated critical habitat.

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, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence CCC coho salmon, nor destroy or adversely modify its designated critical habitat.

2.9. Incidental Take Statement

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

2.9.1. Amount or Extent of Take

The amount of extent of take described below is based on the analysis of effects of the action done in the proceeding biological opinion. If the action is implemented in a manner inconsistent with the project description provided to NMFS, and as a result, take of listed species occurs, such take would not be exempt from section 9 of the ESA. In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

Take of listed juvenile CCC steelhead and CCC coho salmon may occur during fish relocation and dewatering of the San Lorenzo River and Kings Creek between June 1 and October 15. Construction will be completed within three construction seasons, therefore dewatering may

occur up to three times to complete the project. The number of CCC steelhead that may be incidentally taken during dewatering activities is expected to be small, and limited to the pre-smolt and young-of-the-year juvenile life stages. NMFS expects that no more than 2 percent of juvenile CCC steelhead within the dewatered area of the San Lorenzo River and Kings Creek will be injured, harmed, or killed during fish relocation activities. NMFS also expects that no more than 1 percent of the fish within the dewatered areas of the San Lorenzo River and Kings Creek will be injured, harmed, or killed during dewatering activities. When considering the proposed maximum of three dewatering events that might be necessary to complete the work at each site, no more than 84 and 102 juvenile steelhead are expected to be present at the San Lorenzo River and Kings Creek project sites, respectively. Thus, NMFS expects no more than six juvenile steelhead would be injured or killed by fish relocation/dewatering over the life of the project.

Incidental take will have been exceed at the San Lorenzo River project site if:

- more than 28 juvenile CCC steelhead are captured each year;
- more than 84 juvenile CCC steelhead are captured during the life of the project;
- more than one juvenile CCC steelhead are harmed or killed during each year; or
- more than three juvenile CCC steelhead are harmed or killed during the life of the project.

Incidental take will have been exceeded at the Kings Creek project site if:

- more than 34 juvenile CCC steelhead are captured each year;
- more than 102 juvenile CCC steelhead are captured during the life of the project;
- more than one juvenile CCC steelhead are harmed or killed during each year; or
- more than three juvenile CCC steelhead are harmed or killed during the life of the project.

Similarly, the number of CCC coho salmon that may be incidentally taken during the proposed maximum of three dewatering activities at each project site is expected to be small and limited to the pre-smolt and young-of-the-year juvenile life stages. NMFS expects that no more than 2 percent of the juvenile CCC coho salmon within the dewatered area of the San Lorenzo River Kings Creek will be injured, harmed, or killed during fish relocation activities. NMFS also expects that no more than 1 percent of the fish within the dewatered area of the San Lorenzo River and Kings Creek will be injured, harmed, or killed during dewatering activities. When considering the proposed maximum of three dewatering events that might be necessary to complete the work at each site, no more than 15 juvenile CCC coho salmon are expected to be present at both project sites during dewatering. Thus, NMFS expects no more than six juvenile CCC coho salmon will be harmed or killed by the project.

Take will have been exceeded at both project sites if:

- more than 5 juvenile CCC coho salmon are captured each year;

- more than 15 juvenile CCC coho salmon are captured during the life of the project;
- more than one juvenile CCC coho salmon are harmed or killed during each year; or
- more than three juvenile CCC coho salmon are harmed or killed during the life of the project.

2.9.2. Effect of the Take

In the biological 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).

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of juvenile CCC steelhead and juvenile CCC coho salmon:

- undertake measures to ensure that injury and mortality to salmonids resulting from fish relocation and dewatering activities is low;
- undertake measures to minimize harm to salmonids from construction of the project and degradation of aquatic habitat; and
- prepare and submit plans and reports regarding the effects of fish relocation, construction of the project, and post-construction site performance.

2.9.4. Terms and Conditions

The terms and conditions described below are non-discretionary, and Caltrans or any contractor must comply with them in order to implement the RPMs (50 CFR 402.14). Caltrans or any contractor 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. Caltrans or the contractor will allow any NMFS employee(s) or any other person designated by NMFS, to accompany, field personnel to visit the project sites during activities described in this opinion.
    b. Caltrans or the contractor will retain qualitied biologists with expertise in the area of anadromous salmonid biology, including handling, collecting, and relocating salmonids; salmonid/habitat relationships; and biological monitoring of salmonids. Caltrans or the contractor shall ensure that all fisheries biologists working on this project be qualified to conduct fish collections in a manner which minimizes all potential risks to ESA-listed salmonids. Electrofishing, if used,

shall be performed by a qualified biologist and conducted according to the *NOAA Fisheries Guidelines for Electrofishing Waters Containing Salmonids Listed under the Endangered Species Act*, *June 2000.* See: http://www.nwr.noaa.gov/ESA-Salmon-Regulations-Permits/4d Rules/upload/electro2000.pdf.

c. The biologists will monitor the construction sites during placement and removal of cofferdams and channel diversions to ensure that any adverse effects to salmonids are minimized. The biologists will be on site during all dewatering events to capture, handle, and safely relocate salmonids to an appropriate location. The biologist will notify NMFS staff at 707-575-6068 or elena.meza@noaa.gov, one week prior to capture activities in order to provide an opportunity for NMFS staff to observe the activities. During fish relocation activities the fisheries biologist shall contact NMFS staff at the above number, if mortality of federally listed salmonids exceeds three percent of the total for each species collected at each project site, at which time NMFS will stipulate measures to reduce the take of salmonids.

d. Salmonids will be handled with extreme care and kept in water to the maximum extent possible during rescue activities. All captured fish will be kept in cool, shaded, aerated water protected from excessive noise, jostling, or overcrowding any time they are not in the stream, and fish will not be removed from this water except when released. To avoid predation, the biologists will have at least two containers and segregate young-of-year form larger age classes and other potential aquatic predators. Captured salmonids will be relocated, as soon as possible, to a suitable instream location (pre-approved by NMFS) in which suitable habitat conditions are present to allow for adequate survival of transported fish and fish already present.

e. If any steelhead or salmon are found dead or injured, the biological monitor will contact NMFS staff at 707-575-6068 or elena.meza@noaa.gov. The purpose of the contact is to review the activities resulting in take, determine if additional protective measures are required, and to ensure appropriate collection and transfer of salmonid mortalities and tissue samples. All salmonid mortalities will be retained. Tissue samples are to be acquired from each mortality per the methods identified in the NMFS Southwest Fisheries Science Center Genetic Repository protocols (contact the above NMFS office at the phone number provided) and sent to: NOAA Coastal California Genetic Repository, Southwest Fisheries Science Center, 110 McAllister Way, Santa Cruz, California 95060.

f. Non-native fish that are captured during fish relocation activities shall not be relocated to anadromous streams, or areas where they could access anadromous habitat.

2. The following terms and conditions implement reasonable and prudent measure 2:

a. Caltrans will allow any NMFS employee(s) or any other person(s) designated by NMFS to accompany field personnel to visit the project site during activities described in this opinion.

b. c. To ensure that the project is built as designed and contractors adhere to

construction best management practices, monitoring will be performed during construction by skilled individuals. Monitors will be knowledgeable in the project designs, construction minimization measures, and the needs of native fish, including steelhead and Chinook salmon. Monitoring will be performed daily. The monitor(s) will work in close coordination with project management personnel, the project design (engineering) team, and the construction crew to ensure that the project is built as designed.

c. d. Any pumps used to divert live stream flow will be screened and maintained throughout the construction period to comply with NMFS' Fish Screening Criteria for Anadromous Salmonids (2000).

d. e. Construction equipment used within the river channel will be checked each day prior to work within the river channel (top of bank to top of bank) and, if necessary, action will be taken to prevent fluid leaks. If leaks occur during work in the channel, Caltrans or their contractors will contain the spill and removed the affected soils.

e. f. Once construction is completed, all project-introduced material must be removed, leaving the river as it was before construction. Excess materials will be disposed of at an appropriate disposal site.

3. The following terms and conditions implement reasonable and prudent measure 3:

   a. **Project Construction and Fish Relocation Report** – Caltrans must provide a written report to NMFS by January 15 of the year following each construction season. The report must be submitted to NMFS' North-Central Coast Office, Attention: Central Coast Branch Chief, 777 Sonoma Avenue, Room 325, Santa Rosa, California 95404-6528, and via email to elena.meza@noaa.gov. The report must contain, at minimum, the following information:

      i. Construction related activities – The report(s) must include the dates construction began and was completed; a discussion of any unanticipated effects or unanticipated levels of effects on salmonids, including a description of any and all measures taken to minimize those unanticipated effects and a statement as to whether or not the unanticipated effects had any effect on ESA-listed fish; the number of salmonids killed or injured during the project action; and photographs taken before, during, and after the activity from photo reference points.

      ii. Fish relocation – The report(s) must include a description of the location from which fish were removed and the release site(s) including photographs; the date and time of the relocation effort; a description of the equipment and methods used to collect, hold, and transport salmonids; if an electrofisher was used for fish collection, a copy of the logbook must be included; the number of fish relocated by species; the number of fish injured or killed by species and a brief narrative of the circumstances surrounding ESA-listed fish injuries or mortalities; and a description of any problems which may have arisen during the relocation activities and a statement as to whether or not the activities had any unforeseen effects.

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). NMFS has no conservation recommendations as this time.

2.11. Reinitiation of Consultation

This concludes formal consultation for the San Lorenzo River and Kings Creek Bridge Replacement Project.

As 50 CFR 402.16 states, reinitiation of consultation is required and shall be requested by the Federal agency or by the Service 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 identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological 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. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA , EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). 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) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

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

Pacific Coast Salmon EFH may be adversely affected by the proposed action.

3.2. Adverse Effects on Essential Fish Habitat

The potential adverse effects of the project on EFH for Pacific Coast Salmon have been described in the preceding biological opinion and include degraded water quality, benthic disturbance, increased turbidity, and loss of riparian vegetation. As described in the biological opinion above, degraded water quality, benthic disturbance, increased turbidity, and loss of riparian vegetation effects are anticipated to be temporary and minor due to the amount of area impacted relative to the total quantity of habitat available in the action area. Therefore, the effects of the project on ESA-listed species are anticipated to be the same as the effects to EFH in the action area.

3.3. Essential Fish Habitat Conservation Recommendations

Based on information developed in our effects analysis (see preceding biological opinion), NMFS has determined that the proposed action would adversely affect EFH for federally managed CCC coho salmon within the Pacific Salmon FMP. Section 305(b)(4)(a) of the MSA authorizes NMFS to provide EFH conservation Recommendations that will minimize adverse effects of an activity on EFH. Although temporary potential adverse effects are anticipated as a result of the proposed project, the proposed minimization and avoidance measures, and best management practices in the accompanying biological opinion are sufficient to avoid, minimize, and/or mitigate for the anticipated affects. Therefore, no additional EFH Conservation Recommendations are necessary at this time that would otherwise offset the adverse effects to EFH.

3.4. 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)). This concludes the MSA portion of this consultation.

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion is Caltrans. Individual copies of this opinion were provided to the Caltrans. The document will be available within two weeks at the NOAA Library Institutional Repository. The format and naming adheres to conventional standards for style.

4.2. Integrity

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

4.3. Objectivity

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

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

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

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

5. REFERENCES

Abdul-Aziz, O. I, N. J. Mantua, K. W. Myers. 2011. Potential climate change impacts on thermal habitats of Pacific salmon (*Oncorhynchus* spp.) in the North Pacific Ocean and adjacent seas. Canadian Journal of Fisheries and Aquatic Sciences 68(9):1660-1680.

Alexander, G.R., and E.A. Hansen. 1986. Sand bed load in a brook trout stream. North American Journal of Fisheries Management 6:9-23.

Barnhart, R.A. (1986). Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest): Steelhead Biological Report 82-11.60.

Beck, N., E. Freund, and M. Mathias. 2006. Comparative Lagoon Ecological Assessment Project (CLEAP) Santa Cruz County, California. Draft Final. October 2006. 2nd Nature, Inc., in association with the NMFS Southwest Fisheries Science Center, Santa Cruz, CA.

Becker, G. S., I. J. Reining, and D. A. Asbury. 2008. Steelhead/rainbow trout (Oncorhynchus mykiss) resources south of the Golden Gate, California. Center for Ecosystem Restoration and Management.

Berg, L., and T.G. Northcote. 1985. Changes in territorial, gill-flaring, and feeding behavior in juvenile coho salmon *(Oncorhynchus kisutch)* following short-term pulses of suspended sediment. Canadian Journal of Fisheries and Aquatic Sciences 42:1410-1417.

Berggren, T. J., and M. J. Filardo. 1993. An analysis of variables influencing the migration of juvenile salmonids in the Columbia River Basin. N. Am. J. Fish. Man. 13:48-63.

Bjorkstedt, E.P., B.C. Spence, J.C. Garza, D.G. Hankin, D. Fuller, W.E. Jones, J.J. Smith, R. Macedo (2005). An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the North-Central California Coast Recovery Domain. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum, NMFS-SWFSC-382.

Bjornn, T.C. and D.W. Reiser (1991). Habitat requirements of salmonids in W.R. Meehan (ed.), Influence of forest and rangeland management on salmonids fishes and their habitats. Special Publication 19. Bethesda, MD: American Fisheries Society.

Brewer, P.G. and J. Barry. 2008. Rising Acidity in the Ocean: The Other CO2 Problem. Scientific American. October 7, 2008.

Brown, L. R., P. B. Moyle, and R. M. Yoshiyama. 1994. Historical decline and current status of coho salmon in California. North American Journal of Fisheries Management. 14(2):237-261.

Bryant, G. J. 1994. Status review of coho salmon populations in Scott and Waddell Creeks, Santa Cruz County, California. National Marine Fisheries Services Southwest Region, Santa Rosa, California.

Bryant, M.D (1983). The role and management of woody debris in west coast salmonid nursery streams. North American Journal of Fisheries Management 3:322-330.

Burgner, R.L., J.T. Light, L. Margolis, T. Okazaki, A. Tautz, and S. Ito (1992). Distribution and origins of steelhead trout in offshore waters of the North Pacific Ocean. International North Pacific Fisheries Commission, Bulletin 51, Vancouver, B.C.

Busby, P.J., T.C. Wainwright, G.J. Bryant, L. Lierheimer, R.S. Waples, F.W. Waknitz, and I.V. Lagomarsino (1996). Status review of West Coast steelhead from Washington, Idaho, Oregon and California. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NWFSC-27.

Bustard, D.R. and D.W. Narver (1975). Aspects of the winter ecology of juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Salmo gairdneri*). Journal of the Fisheries Research Board of Canada 32: 667-680.

California Department of Foresty and Fire Protection and California Department of Conservation. 2020. Watershed Emergency Response Team Evaluation, CZU Lightening Complex. CA-CZU-005205. California Department of Forestry and Fire Protection and California Department of Conservation California Geological Survey. October 2020.

California Department of Transportation (Caltrans). 2020. Biological Assessment for the San Lorenzo River Bridge and Kings Creek Bridge Replacement Project. Prepared for the National Marine Fisheries Service. North-Central Coast Office. Santa Rosa, California. August.

Chapman, D.W. and T.C. Bjornn (1969). Distribution of salmonids in streams, with special reference to food and feeding. Pages 153-176 in T.G. Northcote (ed.) Symposium on salmon and trout in streams; H.R. Macmillan Lectures in Fisheries. University of British Columbia, Institute of Fisheries.

Cooper J.R., J.W. Gilliam, R.B. Daniels, and W.P. Robarge (1987). Riparian areas as filters for agricultural sediment. Soil Science Society of America Journal. 51:416–420.

Cordone, A.J., and D.W. Kelley. 1961. The influences of inorganic sediment on the aquatic life of streams. California Fish and Game 47:189-228.

County of Santa Cruz. 2018. Draft San Lorenzo River Watershed Management Plan Update. County of Santa Cruz Water Resources Program, Environmental Health Services, and Planning Department, Santa Cruz, California.

Cox, P., and D. Stephenson. 2007. A changing climate for prediction. Science 113:207-208.

Crouse, M.R., C.A. Callahan, K.W. Malueg, and S.E. Dominguez. 1981. Effects of fine sediments on growth of juvenile coho salmon in laboratory streams. Transactions of the American Fisheries Society 110:281-286.

Cushman, R.M. (1985). Review of ecological effects of rapidly varying flows downstream from hydroelectric facilities. North American Journal of Fisheries Management 5: 330-339.

Doney, S. C, M. Ruckelshaus, J. E. Duffy, J. P. Barry, F. Chan, C. A. English, H. M. Galindo, J. M. Grebmeier, A. B. Hollowed, N. Knowlton, J. Polovina, N. N. Rabalais, W. J. Sydeman, L. D. Talley. 2012. Climate Change Impacts on Marine Ecosystems. Annual Review of Marine Science 4:11-37.

D.W. Alley & Associates (DWAA). 2006. Comparison of Juvenile Steelhead Densities, 1997-2001 and 2003-2005, In the middle and Upper San Lorenzo River and 5 Tributaries, Santa Cruz County, California; With an Index of the Juvenile Population Size and Adult Returns. Brookdale, CA: D.W. Alley & Associates.

DWAA 2007. Determination of 2006 juvenile steelhead densities in the Middle and Upper San Lorenzo River and five tributaries, Santa Cruz County; with an index of the juvenile population size and adult returns. Brookdale, California: D.W. Alley & Associates.

DWAA 2008. 2007 Juvenile Steelhead Densities in the San Lorenzo, Soquel, Aptos and Corralitos Watersheds, Santa Cruz County, California, With Trend Analysis of the San Lorenzo and Soquel Watersheds, 1997-2008. Prepared For the Santa Cruz County Environmental Health Department. Brookdale, CA; D.W. Alley & Associates.

DWAA 2015. 2015 summary report – juvenile steelhead densities in the San Lorenzo, Soquel, Aptos and Pajaro watersheds, Santa Cruz County, CA; with Appendix B: Detailed analysis of 2016 steelhead monitoring in the San Lorenzo, Soquel, Aptos and Corralitos watersheds.

DWAA 2019. Biological Assessment, Impact Analysis and Mitigation Measures for Fishery Resources at the Huckleberry Island Bridge Abutment Removals Along the San Lorenzo River in Brookdale, CA – March 2019. *Prepared for*: Biotic Resources Group, Soquel, California. *Prepared by*: D.W. Alley & Associates, Brookdale, California. 27 pages.

Eisler, R. (2000). Handbook of chemical risk assessment: Health hazards to humans, plants, and animals. Volume 1, Metals. Boca Raton, FL, Lewis Press.

Feely, R. A., C. L. Sabine, K. Lee, W. Berelson, J. Kleypas, V. J. Fabry, and F. J. Millero. 2004. Impact of anthropogenic CO2 on the CaCO3 system in the oceans. Science 305, 362-366.

Good, T.P., R.S Waples, and P. Adams (2005). Updated status of federally listed ESUs of West Coast salmon and steelhead, U.S. Department of Commerce: 598.

Gregory, R.S., T.G. Northcote. 1993. Surface, Planktonic, and Benthic Foraging by Juvenile Chinook Salmon (*Oncorhynchus tshawytscha*) in Turbid Laboratory Conditions. Canadian Journal of Fisheries and Aquatic Sciences 50: 233-240.

Hagar Environmental Science. 2005. Mount Hermon Summer Dam Improvement Project Fish Removal Activities. Technical Memorandum. *Prepared for*: Mount Hermon Association, Inc., Mount Hermon, California. *Prepared by*: Hagar Environmental Science, Richmond, California. November 8, 2005.

Hagar Environmental Science. 2014. City of Santa Cruz Habitat Conservation Plan Lagoon Surveys 2013. Technical Memorandum to Chris Berry, City of Santa Cruz Water Department. Hagar Environmental Science.

Hagar Environmental Science. 2015. City of Santa Cruz Habitat Conservation Plan Lagoon Surveys 2014. Technical Memorandum to Chris Berry, City of Santa Cruz Water Department. Hagar Environmental Science.

Harvey, B. C. (1986). "Effects of Suction Gold Dredging on Fish and Invertebrates in Two California Streams." North American Journal of Fisheries Management 6(3): 401-409.

Hassler, T. J. 1987. Species profiles: life histories and environmental requirements of coastal fishes and invertebrates (Pacific Southwest) coho salmon. U.S. Fish and Wildlife Service, Biological Report. 82(11.70). U.S. Army Corps of Engineers, TR EL.

Hayes, S.A., M.H. Bond, C.V. Hanson, E.V. Freund, J.J. Smith, E.C. Anderson, A.J. Ammann, and B.R. MacFarlane (2008). Steelhead growth in a small Central California watershed: Upstream and estuarine rearing patterns. Transactions of the American Fisheries Society 137: 114-128.

Hayhoe, K., D. Cayan, C. B. Field, P. C. Frumhoff, E. P. Maurer, N. L. Miller, S. C. Moser, S. H. Schneider, K. N. Cahill, E. E. Cleland, L. Dale, R. Drapek, R. M. Hanemann, L. S. Kalkstein, J. Lenihan, C. K. Lunch, R. P. Neilson, S. C. Sheridan, and J. H. Verville. 2004. Emissions pathways, climate change, and impacts on California. Proceedings of the National Academy of Sciences of the United States of America, volume 101: 12422-12427.

Hokanson, K.E.F., C.F. Kleiner, and T.W. Thorslund (1977). Effects of constant temperatures and diel temperature fluctuations on specific growth and mortality rates and yield of juvenile rainbow trout, *Salmo gairdneri*. Journal of the Fisheries Research Board of Canada 34: 639- 648.

Holtby, L. B., B. C. Anderson, and R. K. Kadowaki. 1990. Importance of smolt size and early ocean growth to interannual variability in marine survival of coho salmon (*Oncorhynchus kisutch*). Canadian Journal of Fisheries and Aquatic Sciences 47(11):2181-2194.

Hubert, W.A. (1996). Passive capture techniques. In B. Murphy and D. Willis (eds.) Fisheries Techniques. Bethesda, Maryland, American Fisheries Society.

Johnson, S. L. 1988. The effects of the 1983 El Nino on Oregon's coho salmon (*Oncorhynchus kisutch*) and Chinook (O. tshawytscha) salmon. Fish. Res. 6:105-123.

Kadir, T., L. Mazur, C. Milanes, and K. Randles. 2013. Indicators of Climate Change in California. California Environmental Protection Agency, Office of Environmental Health Hazard Assessment Sacramento, CA

Keeley, E.R. (2003). An experimental analysis of self-thinning in juvenile steelhead trout. Oikos 102: 543-550.

Lindley, S. T., R. S. Schick, E. Mora, P. B. Adams, J. J. Anderson, S. Greene, C. Hanson, B. P. May, D. R. McEwan, R. B. MacFarlane, C. Swanson, and J. G. Williams. 2007. Framework for assessing viability of threatened and endangered Chinook salmon and steelhead in the Sacramento-San Joaquin Basin. San Francisco Estuary and Watershed Science, 5.

Lisle, T.E. (1986). Effects of woody debris on anadromous salmonid habitat, Prince of Wales Island, Southeast Alaska. North American Journal of Fisheries Management 6: 538-550.

McCarthy, N.F. 1994. Where Grizzlies Roamed the Canyons. Garden Court Press, Palo Alto, California.

McCarthy, S.G., J.J. Duda, J.M. Emilen, G.R. Hodgson, and D.A. Beauchamp (2009). Linking habitat quality with trophic performance of steelhead along forest gradients in the South Fork Trinity River watershed, California. Transactions of the American Fisheries Society 138: 506–521.

McElhany, P., M. H. Ruckelshaus, M. J. Ford, T. C. Wainwright, and E. P. Bjorkstedt. 2000. Viable salmonid populations and the recovery of evolutionarily significant units. National Marine Fisheries Services, Northwest Fisheries Science Center and Southwest Fisheries Science Center.

McMahon, T. E. 1983. Habitat suitability index models: coho salmon. United States Fish and Wildlife Service, FWS/OBS-82/10.49.

Mitsch, W.J. and J.G. Gosselink (2000). Wetlands, 3rd ed. John Wiley & Sons, New York.

Moser, S., J. Ekstrom, and G. Franco. 2012. Our Changing Climate 2012 Vulnerability and Adaptation to the Increasing Risks from Climate Change in California. A Summary Report on the Third Assessment from the California Climate change Center. July. CEC-500-20102-007S.

Moyle, P.B. (2002). Inland fishes of California. University of California Press, Berkeley and Los Angeles, California.

Moyle, P.B., JA. Israel, and SE. Purdy (2008). Salmon, steelhead, and trout in California: Status of an emblematic fauna. Report commissioned by California Trout. University of California Davis Center for Watershed Sciences, Davis, CA.

Murphy, M.L., and W.R. Meehan (1991). Stream ecosystems. In W.R. Meehan (ed.) Influences of forest and rangeland management on salmonid fishes and their habitats. American Fisheries Society, Special Publication Number 19**:** 17-46.

Myrick, C., and J.J. Cech, Jr. (2005). Effects of temperature on the growth, food consumption, and thermal tolerance of age-0 Nimbus-strain steelhead. North American Journal of Aquaculture 67:324-330.

Nielsen, J. L. 1992. Microhabitat-specific foraging behavior, diet, and growth of juvenile coho salmon. Transactions of the American Fisheries Society 121:617-634.

Nielson, J.L. and M.C. Fountain (2006). Microsatellite diversity in sympatric reproductive ecotypes of Pacific steelhead (*Oncorhynchus mykiss*) from the Middle Fork Eel River, California. Ecology of Freshwater Fish 8: 159-168.

National Marine Fisheries Service (NMFS). (2000). Guidelines for electrofishing waters containing salmonids listed under the Endangered Species Act. National Marine Fisheries Service, Protected Resources Division, Santa Rosa, California.

National Marine Fisheries Service (NMFS). (2012). Final Recovery Plan for Central California Coast coho salmon Evolutionarily Significant Unit. National Marine Fisheries Service, Southwest Region, Santa Rosa, California.

National Marine Fisheries Service (NMFS) (2016). 5-year Review: Summary & Evaluation of Central California Coast Coho Salmon. National Marine Fisheries Service, West Coast Region. California Coastal Office, Santa Rosa, California.

National Marine Fisheries Service (NMFS) (2016a). Final coastal multispecies recovery plan: California Coastal Chinook salmon, Northern California steelhead, Central California Coast steelhead. National Marine Fisheries Service, West Coast Region. California Coastal Office, Santa Rosa, California.

Osterback, A.K., C.H. Kern, E.A. Kanawi, J.M. Perez, and J.D. Kiernan (2018). The effects of early sandbar formation on the abundance and ecology of coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*) in a Central California coastal lagoon. Canadian Journal of Fisheries and Aquatic Sciences.

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.

Platts, W.S. (1991). Livestock grazing. In W.R. Meehan (ed.) Influence of forest and rangeland management on Salmonid fishes and their habitats. American Fisheries Society, Special Publication 19: 389-423.

Poole, G.C., and C.H. Berman (2001). An ecological perspective on in-stream temperature: natural heat dynamics and mechanisms of human-caused thermal degradation. Environmental Management 27: 787-802.

Rood, R.C. 1975. The historical geography and environmental impact of the lumber industry of the Santa Cruz Mountains. Senior thesis. University of California at Santa Cruz.

Ruggiero, P., C. A. Brown, P. D. Komar, J. C. Allan, D. A. Reusser, H. Lee, S. S. Rumrill, P. Corcoran, H. Baron, H. Moritz, J. Saarinen. 2010. Impacts of climate change on Oregon's coasts and estuaries. Pages 241-256 *in* K.D. Dellow and P. W. Mote, editors. Oregon Climate Assessment Report. College of Oceanic and Atmospheric Sciences, Oregon State University, Corvallis, Oregon.

Sandercock, F. K. 1991. Life history of coho salmon. Pages 397-445 *in* C. Groot, and L. Margolis, editors. Pacific salmon life histories. University of British Columbia Press, Vancouver, B.C. Santa Cruz County Planning Department. 1979. The San Lorenzo River Watershed Management Plan.

San Lorenzo Valley Water District. 2009. San Lorenzo Valley Water District Watershed Management Plan, Final Version. Part I: Existing Conditions Report.

Santa Cruz County Planning Department. 1979. The San Lorenzo River Watershed Management Plan.

Santer, B. D., C. Mears, C. Doutriaux, P. Caldwell, P. J. Gleckler, T. M. L. Wigley, S. Solomon, N. P. Gillett, D. Ivanova, T. R. Karl, J. R. Lanzante, G. A. Meehl, P. A. Stott, K. E. Talyor, P. W. Thorne, M. F. Wehner, and F. J. Wentz. 2011. Separating signal and noise in atmospheric temperature changes: The importance of timescale. Journal of Geophysical Research 116: D22105.

Satterthwaite, W.H., M.P. Beakes, E.M. Collins, D.R. Swank, J.E. Merz, R.G. Titus, S.M. Sogard, and M. Mangel (2009). Steelhead life history on California's Central Coast: Insights from a state-dependent model. Transactions of the American Fisheries Society 138: 532–548.

Scavia, D., J. C. Field, D. F. Boesch, R. W. Buddemeier, V. Burkett, D. R. Cayan, M. Fogarty, M. A. Harwell, R. W. Howarth, C. Mason, D. J. Reed, T. C. Royer, A. H. Sallenger, and J. G. Titus. 2002. Climate Change Impacts on U.S. Coastal and Marine Ecosystems. Estuaries, volume 25(2): 149-164.

Schneider, S. H. 2007. The unique risks to California from human-induced climate change. California State Motor Vehicle Pollution Control Standards; Request for Waiver of Federal Preemption, presentation May 22, 2007.

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.

Shapovalov, L., and A.C. Taft (1954). The life histories of the steelhead rainbow trout (*Salmo gairdneri gairdneri*) and silver salmon (*Oncorhynchus kisutch*) with special reference to Waddell Creek, California, and recommendations regarding their management. Fish Bulletin 98.

Shirvell, C. (1990). Role of instream rootwads as juvenile coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*O. mykiss*) cover habitat under varying streamflows. Canadian Journal of Fisheries and Aquatic Sciences 47: 852-861.

Sigler, J.W., T.C. 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: 142-150.

Smith, A.K. (1973). Development and application of spawning velocity and depth criteria for Oregon salmonids. Transactions of the American Fisheries Society 102:312- 316.

Smith, J.J. and H. Li, W. (1983). Energetic factors influencing foraging tactics of juvenile steelhead trout, *Salmo gairdneri*. In: D.L.G. Noakes, D.G. Lingquist, G.S. Helfman, and J.A. Ward (eds.) Predators and prey in fishes. The Hague, The Netherlands.

Smith, J.J. (1990). The effects of sandbar formation and inflows on aquatic habitat and fish utilization in Pescadero, San Gregorio, Waddell, and Pomponio Creek estuary/lagoon systems, 1985-1989. Prepared for California Department of Parks and Recreation. Report Interagency Agreement 84-04-324, San Jose State University.

Sogard, S.M., J.E. Merz, W.H. Satterthwaite, M.P. Beakes, D.R. Swank, E.M. Collins, R.G. Titus, and M. Mangel (2012). Contrasts in habitat characteristics and life history patterns of *Oncorhynchus mykiss* in California's Central Coast and Central Valley. Transactions of the American Fisheries Society 141:747–760.

Spence, B. C., E. P. Bjorkstedt, J. C. Garza, J. J. Smith, D. G. Hankin, D. Fuller, W. E. Jones, R. Macedo, T. H. Williams, and E. Mora. 2008. A Framework for Assessing the Viability of Threatened and Endangered Salmon and Steelhead in the North-Central California Coast Recovery Domain U.S. Department of Commerce, National Marine Fisheries Service, Southwest Fisheries Service Center, NOAA-TM-NMFS-SWFSC-423, Santa Cruz, CA.

Spence, B., W.G. Duffy, J.C. Garza, S.M. Sogard, L.A. Weitkamp, T.H. Williams, and D.A. Boughton. 2011. Historical occurrence of coho salmon (Oncorhynchus kisutch) in streams of the Santa Cruz Mountain Region of California: Response to an Endangered Species Act petition to delist coho salmon south of San Francisco Bay. U.S. Department of Commerce. NOAA Technical Memorandum. NOAA-TM-NMFS-SWFSC-472.

Spence, B. C., E. P. Bjorkstedt, S. Paddock, and L. Nanus. 2012. Updates to biological viability criteria for threatened steelhead populations in the north-central California coast recovery domain. U.S. Department of Commerce, National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service, Southwest Fisheries Science Center, Fisheries Ecology Division. March 2012.

Swanson Hydrology and Geomorpholoy, Native Vegetation Network, and Hagar Environmental Science. 2002. Lower San Lorenzo River and Lagoon management plan. Prepared for the City of Santa Cruz Redevelopment Agency.

Thomas, V. G. (1985). "Experimentally determined impacts of a small, suction gold dredge on a Montana stream." North American Journal of Fisheries Management 5: 480-488.

Thrower, F.P., J.J. Hard, and J.E. Joyce (2004). Genetic architecture of growth and early life-history transitions in anadromous and derived freshwater populations of steelhead. Journal of Fish Biology. 65: 286-307.

Turley, C. 2008. Impacts of changing ocean chemistry in a high-CO2 world. Mineralogical Magazine, February 2008, 72(1). 359-362.

U.S. Environmental Protection Agency (USEPA) (2001). Issue Paper 5: Summary of technical literature examining the effects of temperature on salmonids. Region 10, Seattle, WA. EPA 910-D-01-005.

Velagic, E. 1995. Turbidity study: a literature review. Prepared for Delta planning branch, California Department of Water Resources by Centers for Water and Wildland Resources, University of California, Davis.

Waters, T.F. 1995. Sediment in Streams: Sources, Biological Effects, and Control. American Fisheries Society Monograph 7. American Fisheries Society, Bethesda, Maryland. 251 pages.

Weitkamp, L. A., T. C. Wainwright, G. J. Bryant, G. B. Milner, D. J. Teel, R. G. Kope, and R. S. Waples. 1995. Status review of coho salmon from Washington, Oregon, and California. United States Department of Commerce, National Oceanic and Atmospheric Administration Technical Memorandum NMFS-NWFSC-24. 258 pages.

Welsh, H., H., G. R. Hodgson, B. C. Harvey, and M. E. Roche. 2001. Distribution of juvenile coho salmon in relation to water temperatures in tributaries of the Mattole River, California. North American Journal of Fisheries Management 21:464-470.

Wesche, T.A., C.M. Goertler, and C.B. Frye (1987). Contribution of riparian vegetation to trout cover in small streams. North American Journal of Fisheries Management 7: 151-153.

Westerling, A. L., B. P. Bryant, H. K. Preisler, T. P. Holmes, H. G. Hidalgo, T. Das, and S. R. Shrestha. 2011. Climate change and growth scenarios for California wildfire. Climatic Change 109:(Suppl 1):S445–S463.

Williams, T.H., S.T. Lindley, B.C. Spence, and D.A. Boughton (2011). Status review update for Pacific salmon and steelhead listed under the Endangered Species Act: Southwest. 20 May 2011 update to 5 January 2011 report to Southwest Region National Marine Fisheries Service from Southwest Fisheries Science Center, Fisheries Ecology Division. Santa Cruz, California.

Williams, T.H., B.C. Spence, D.A. Boughton, R.C. Johnson, L. Crozier, N. Mantua, M. O'Farrell, and S.T. Lindley (2016). Viability assessment for Pacific salmon and steelhead listed under the Endangered Species Act: Southwest. 2 February 2016 report to West Coast Region National Marine Fisheries Service from Southwest Fisheries Science Center, Fisheries Ecology Division. Santa Cruz, California.

Wurtsbaugh, W.A., and G.E. Davis (1977). Effects of temperature and ration level on the growth and food conversion efficiency of *Salmo gairdneri*, Richardson. Journal of Fish Biology 11:87-98.

Zedonis, P.A., and T.J. Newcomb (1997). An evaluation of flow and water temperatures during the spring for protection of salmon and steelhead smolts in the Trinity River, California. United States Fish and Wildlife Service, Arcata, CA.