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

March 13, 2020 **Refer to NMFS No:** WCRO-2019-03810

Lawrence M. Riley
Chief, Wildlife and Sport Fish Restoration Program
U.S. Fish and Wildlife Service
2800 Cottage Way, Suite W-1916
Sacramento, California 95825-1846

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the California Department of Fish and Wildlife's Northern Region Fish Habitat and Passage Program

Dear Mr. Riley:

Thank you for your November 27, 2019, letter 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 California Department of Fish and Wildlife's (CDFW) Northern Region Fish Habitat and Passage Program.

Based on the best scientific and commercial information available, NMFS concluded in the enclosed biological opinion that the proposed action is not likely to jeopardize the continued existence of the Southern Oregon/Northern California coast (SONCC) coho salmon, Sacramento River winter-run Chinook salmon, and Central Valley (CV) spring-run Chinook salmon evolutionarily significant units, and CV steelhead Distinct Population Unit or adversely affect designated critical habitat for these species. However, NMFS anticipates incidental take of SONCC coho salmon, winter run Chinook salmon, CV spring run Chinook salmon, and CV steelhead will occur as a result of dewatering work areas during the proposed action. An incidental take statement with non-discretionary terms and conditions is included with the enclosed biological opinion.

NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)), and concluded that the action would have adverse effects on the EFH of Pacific Coast salmon. Therefore, we have included the results of that review in Section 3 of the enclosed document. No EFH conservation recommendations are provided.

Please contact Roman Pittman at NMFS' Northern California Office in Arcata, California at (707) 825-5167 or email roman.pittman@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Enclosure

cc: Julie Hana, USFWS, Sacramento, CA
Jason Roberts, CDFW, Redding, CA
Copy to ARN File #151422WCR2019AR00266

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

California Department of Fish and Wildlife's
Northern Region Fish Habitat and Passage Program

NMFS Consultation Number: WCRO-2019-03810
Action Agency: U.S. Fish and Wildlife Service

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?
Southern Oregon/Northern California Coast (SONCC) coho salmon *(Oncorhynchus kisutch)*	Threatened	Yes	No	Yes	No
Central Valley steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Sacramento River winter-run Chinook salmon (*O. tshawytscha*)	Endangered	Yes	No	Yes	No
Central Valley spring-run Chinook salmon (*O. tshawytscha*)	Threatened	Yes	No	Yes	No

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: March 13, 2020

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1 INTRODUCTION

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

1.1 Background

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

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

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

1.2 Consultation History

On November 27, 2019, the U.S. Fish and Wildlife Service (FWS) submitted a final Biological Assessment (BA) and formal request for consultation.

On December 3, 2019, FWS emailed NMFS to clarify that they have determined designated critical habitats for the salmonids under this consultation are not likely to be adversely affected.

On December 12, 2019, the California Department of Fish and Wildlife (CDFW) clarified to NMFS via email possible emergency actions that may take place as part of the proposed action.

From January 21, 2019 to March 6, 2020 NMFS and CDFW corresponded to clarify minimization measures for their screen operations and maintenance.

1.3 Proposed Federal Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). For EFH consultation, 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).

FWS proposes to fund CDFW's Fish Habitat and Passage Program (Fish Habitat and Passage Program) via the Sport Fish Restoration Act to maintain a large number of fish screen and passage facilities on private, state, and federal lands within their Northern Region. The Sport Fish Restoration Act directs FWS to provide federal aid to states for the "fish restoration and management projects designed for the restoration and management of all species of fish that have material value in connection with sport or recreation in the marine and/or fresh waters of the United States." The CDFW's Fish Habitat and Passage Program in the Northern Region includes Shasta, Siskiyou, Trinity, and Tehama counties. Fish ladders have been constructed on dams and fish screens installed on many agricultural diversions. These facilities are privately owned and need regular inspection, maintenance, and repair to provide benefit to fishery resources. Funding for the project also includes stream and lake habitat improvements as well as upgrading of fishing access at various sites within the Region. Maintenance of these facilities will continue the protection of listed species and improve public sport-fishing opportunities.

Activities associated with maintenance may include dewatering and fish relocation and total screen replacement which are described in detail in the best management practices (BMPs) section of CDFW's submitted BA. Any other fish relocation activities that may occur in the vicinity of agricultural diversion sites will need to be conducted under a separate program for ESA coverage. As such, the effects of ad hoc fish relocation are not analyzed as part of the effects of the proposed action in this Biological Opinion.

CDFW Fish Habitat Program staff will operate and maintain 58 fish screens and associated bypass return systems along with 15 fish ladders and 2 baffled structures. The Fish Habitat and Passage Program does not operate the water diversions where the fish screen, ladder, and/or baffles are located. Fish screen sites are usually located within irrigation canals downstream of a head gate or similar control structure. Screen sites typically consist of a concrete slab structure and retaining walls. A metal framework is mounted within the concrete walls and supports screen panels and a cleaning mechanism. A bypass allows screened fish to return to the stream via pipe or ditch, preventing entrainment mortality. All screens currently meet CDFW and NMFS criteria for mesh size. Existing roads or trails will continue to be utilized for access to all sites. All reasonable precautions would be taken to assure that no listed salmonids are present prior to initiation of work. Maintenance and fish passage operation activities will be conducted for a period of ten years.

Except for emergencies, fish screen maintenance will occur after screen components are installed at existing sites in the spring, prior to activation of the diversion, although some screens are kept within the screen bay structure even when not in use. Routine maintenance work at each site is expected to be completed within two days. The majority of work is conducted outside the screen bay using hand tools. Work begins with a visual inspection after which fish may be herded from the site using a seine. Fish may also be captured via electrofishing and relocated prior to dewatering for maintenance activity in compliance with listed BMPs. All electrofishing will be performed by a qualified fisheries biologist and conducted according to NMFS guidelines. Following closure of the head gate and dewatering, each site is cleaned by hand or with heavy equipment to remove any accumulated sediment or debris. During past operations, most organic material removed by CDFW consisted of broken, loose, floating debris. Larger material (10 cm or more in diameter and one meter or greater in length) will be removed from diversion and passage structures and placed in the channel downstream. Heavy equipment shall remain on the bank and reach into the screen bay from existing access pathways. CDFW staff may also slowly open the bypass to allow the site to flush rather than cleaning the area manually. Prior to flushing, staff will inspect the bypass outlet return location to ensure that any fish that exit the screen bay during the operation will have suitable habitat available. If not, bypass pipe length may be adjusted to reach suitable habitat. Debris will only be removed from the trough when it is absolutely necessary using hand tools or by machinery reaching into the channel.

The site will be dewatered according to BMPs if screen removal is necessary. Coffer dams will be installed and water bypassed through an appropriately screened diversion. Fish will be relocated by standard methodologies, including electrofishing. All electrofishing will be conducted according to NMFS protocol by a qualified biologist and any waste water will be discharged to a site where it cannot reenter the stream. Screens will be reinstalled prior to reintroduction of flow. All screens are subject to documented inspection two to three times per week to ensure functionality. The frequency of maintenance for each screen is dependent upon tributary conditions and length and season of use. Most head gates are closed until March, preventing fish access to the diversion area until spring maintenance begins. Screens that sustain damage, have potential for greater biological impacts, acquire heavy debris loads or are active year round to provide for stock water require more frequent maintenance. In addition to removal of sediment and debris, screen maintenance may include lubrication, repair or replacement of damaged parts, adjustments of associated structure (e.g., wipers and paddle wheels) and manipulation of bypass return flows as needed. Velocity testing will be conducted if new screens are installed. If screens have porosity controls, then the approach and sweeping velocity will be tested at the start of the irrigation season to ensure compliance with NMFS latest design requirements. Of the 58 screens, 54 screens currently do not meet NMFS fish screen criteria due to lack of porosity control and louvers to meet approach and sweeping velocities. However, CDFW will backwater these screens to meet approach and sweeping velocities (Roberts 2020). CDFW plans to upgrade 14 screening facilities to comply with NMFS criteria within 12 months. When irrigation season ends (typically in October or November), screen components may be removed manually or by heavy equipment and then transported to a CDFW facility for upgrading. At certain times of the year, screen configuration, panel style and/or size may also be altered.

Most bypass pipes are currently buried and the remainder will eventually be located underground as well. Therefore, no maintenance is required other than outfall inspection. Depth will be maintained at bypass outlets to ensure that fish are not discharged onto shallow, rocky areas. Remaining exposed pipes will be inspected along with associated screens. Bypass structures are sized to meet criteria specific to each site and to pass adult fish. Bypass flow will be adjusted by operating a waterman valve or altering the number of flash boards to avoid delayed fish passage or stranding. Open ditch bypasses are visually inspected from the screen bay to the outlet. Any damaged sites will undergo immediate assessment of repair needs.

CDFW operates and maintains a variety of fish ladder structures, most of which are concrete with a few constructed of steel (e.g., Denil fish ladders). Baffle maintenance involves removing debris and any fine sediment collected by the baffle structure. During adult migration periods, passage structure sites are inspected weekly. The remainder of the year they are inspected monthly. Fish ladder maintenance involves removal of ladder debris and hydraulic step adjustments. This is achieved by slowly removing and replacing dam boards making up individual steps to increase flow and modify depth and water surface elevations. In Alaskan step pass, baffle or Denil style ladders, debris is agitated and allowed to flush through the structure. Heavy equipment may be used to remove larger debris deposits if existing access is available.

Heavy debris loading typically occurs outside the window when fish are present. However, if salmonids are present, the ladder will be isolated and fish allowed to migrate or gently herded out prior to debris removal. If necessary, they will be relocated in compliance with BMPs. Fishway entrance pool depth will be maintained on all structures.

Due to the unpredictable nature of weather, storm events, and high runoff on unregulated streams, some emergency repairs of screen and passage structures may be required. Emergency repair events are expected to occur only sporadically over the life of the project, typically following storm events as receding flows allow. Procedures and adverse effects for repair will be very similar to those for maintenance with project BMP protocols applied to site isolation and fish translocation. The exact nature of emergency events cannot fully be known and described, but a generalized description of possible events and CDFW's likely response is outlined in Table 1 below.

Table 2. CDFW Emergency Repair Response

Emergency Failure	CDFW Response
Failure of screen panel or frame system.	Following landowner closure of the head gate, CDFW will isolate the affected area and repair the screen and/or frame.
A fish screen bypass return pipe plugs with debris or breaks.	Following landowner closure of the head gate, CDFW will close the bypass return and repair or clean the structure as needed. If necessary, fish will be relocated.
A passage structure becomes clogged with debris, breaks, or becomes otherwise nonfunctional following a high flow event.	After flow recedes, CDFW will herd any fish from the site and close access to the structure. CDFW will then complete repairs and/or debris removal.

Stream and lake habitat improvements will include; the installation and maintenance of cattle exclusion fencing, installation of Christmas trees in various reservoirs, and placement of woody material in Big Springs and Little Springs creeks. These activities will protect riparian function and improve salmonid habitat. An all-terrain vehicle will be used to inspect fence lines and will operate exclusively from existing trails and roads. Fencing may cross streams, but will be suspended above the water surface such that it does not interact with the vast majority of possible flows. New cattle exclusion fencing will be constructed along the Shasta River, Big Springs Creek, and Little Springs Creek. Christmas trees will be anchored to reservoir banks with cables and concrete weights during periods of low water at Greensprings and Dorris reservoirs in Modoc County, Bass Lake, Trout Lake, Orr Lake, Juanita Lake, Lake Siskiyou, and Lake Shastina in Siskiyou County, and Whiskeytown Reservoir in Shasta County. Existing roads will be used to anchor the trees unless water levels are too high to place trees from the bank, in which case boats will be used.

All work activity at fishing access sites will be conducted outside of the channel and during the summer months. Potholes will be filled by hand at the Sawmill and Cemetery fishing access sites in Trinity County. River access trails will be manually cleared of encroaching Himalayan berry and other vegetation. Two launch ramps on the Klamath River in Siskiyou County will be repaired manually as needed. Fencing may be installed and any potholes or eroded areas filled by hand. Turnstiles, gates, and signage at the Deer Creek fishing access area will be repaired using hand tools.

We considered whether the proposed action would cause any other activities and determined that it would not. Screen and fish passage structures have been installed to protect fish from entrainment at existing diversions and facilitate passage at existing barriers.

2 ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

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

2.1 Analytical Approach

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

This 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 for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214).

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

The 2019 regulations define the 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' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential PBFs that help to form that conservation value.

2.2.1 Species Description and General Life History

2.2.1.1 SONCC coho salmon

Most coho salmon have a 3-year life history, though some may spend more than one year in freshwater, which can make the analysis of age at return and cohort structure challenging (Bennett et al. 2015). The adults typically migrate from the ocean and into bays and estuaries towards their freshwater spawning grounds in late summer and fall, and spawn by mid-winter. Adults die after spawning. The eggs are buried in nests, called redds, in the rivers and streams where the adults spawn. The eggs incubate in the gravel until fish hatch and emerge from the gravel the following spring as fry. These 0+ age fish typically rear in freshwater for about 15 months before migrating to the ocean. The juveniles go through a physiological change during the transition from fresh to salt water called smoltification. Coho salmon typically rear in the ocean for two growing seasons, returning to their natal streams as 3-year old fish to renew the cycle. Male jacks return at age 2, after spending approximately six months at sea, providing important genetic material across cohorts, such that each cohort does not become reproductively isolated from the others.

2.2.1.2 Central Valley Steelhead

Steelhead probably have the most diverse life history of any of any salmonid (Quinn 2005). There are two basic steelhead life history patterns: winter-run and summer-run (Quinn 2005, Moyle 2002). Winter-run steelhead enter rivers and streams from December to March in a sexually mature state and spawn in tributaries, often ascending long distances (Moyle 2002). Steelhead in the Central Valley historically consisted of both summer-run and winter-run Chinook salmon migratory forms. Only winter-run (ocean maturing) steelhead currently are found in California Central Valley rivers and streams as summer-run have been extirpated (McEwan and Jackson 1996; Moyle 2002). Spawning generally takes place in the late winter or early spring. Eggs hatch in 3 to 4 weeks and fry emerge from the gravel 2 to 3 weeks later (Moyle 2002). Juveniles spend 1 to 4 years in freshwater before migrating to estuaries and the ocean where they spend 1 to 3 years before returning to freshwater to spawn. Another expression of the life history diversity of steelhead is the “half pounder” - sexually immature steelhead that spend about 3 months in estuaries or the ocean before returning to lower river reaches on a feeding run (Moyle 2002). Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby et al. 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Busby et al. 1996). Some steelhead "residualize," becoming resident trout and never adopting the anadromous life history. Central Valley streams contain only winter steelhead but a summer run may have existed prior to widespread construction of dams. They may enter freshwater as early as August, with a peak from September into October. These fish will hold, awaiting higher flows to enter tributaries and spawn (Moyle 2002).

2.2.1.3 Chinook salmon

Chinook salmon follow the typical life cycle of Pacific salmon in that they hatch in freshwater, migrate to the ocean, and return to freshwater to spawn. Diversity within this life cycle exists, however, in the time spent at each stage. Juvenile Chinook salmon are classified into two groups, ocean-type and stream-type, based on the period of freshwater residence (Healey 1991). Ocean-type Chinook salmon spend a short period of time in freshwater after emergence, typically migrating to the ocean within their first year of life. Stream-type Chinook salmon reside in freshwater for a longer period, typically a year or more, before migrating to the ocean. After emigration, Chinook salmon remain in the ocean for two to five years (Healey 1991) tending to stay in the coastal waters of California and Oregon. Chinook salmon are also characterized by the timing of adult returns to freshwater for spawning, with the most common types referred to as fall-run and spring-run fish. Typically, spring-run fish have a protracted adult freshwater residency, sometimes spawning several months after entering freshwater, and produce stream-type progeny. Fall-run fish spawn shortly after entering freshwater and generally produce ocean-type progeny. Winter-run chinook are found only in the Sacramento River and Battle Creek within the action area for this project, entering freshwater in an immature state in the winter and holding over to spawn in the early summer. Most adults return as 3-year olds and are physically small with lower fecundity relative to other runs. Juveniles spend about five to 10 months in the stream after emergence (Moyle 2002).

2.2.2 Status of Species and Critical Habitat

In this biological opinion, NMFS assesses four population viability parameters to help us understand the status of each species and their ability to survive and recover. These population viability parameters are: abundance, population productivity, spatial structure, and diversity (McElhaney et al. 2000). While there is insufficient information to evaluate these population viability parameters in a thorough quantitative sense, NMFS has used existing information, including the Recovery Plan for SONCC coho salmon (NMFS 2014a) to determine the general condition of each population and factors responsible for the current status of each Distinct Population Segment (DPS) or Evolutionarily Significant Unit (ESU). We use these population viability parameters as surrogates for numbers, reproduction, and distribution, the criteria found within the regulatory definition of jeopardy (50 CFR 402.02).

2.2.2.1 Status of SONCC Coho Salmon

Although long-term data on coho salmon abundance are scarce, the available evidence from short-term research and monitoring efforts indicate that spawner abundance has declined since the last status review for populations in this ESU (Williams et al. 2016). Coho salmon abundance, including hatchery stocks, has declined at least 70% since the 1960s, and is currently 6 to 15% of the population observed during the 1940's (CDFW 2004). Most of the 30 independent populations in the ESU are at high risk of extinction because they are likely below their depensation threshold, which can be thought of as the minimum number of adults needed for survival of a population. The most recent status review was completed in 2016, and NMFS determined that drought and ocean conditions seem to be driving recent declines in abundance, however there does not appear to be a change in extinction risk since the 2011 status review (NMFS 2016b).

The distribution of SONCC coho salmon within the ESU is reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which SONCC coho salmon are now absent (NMFS 2001, Good et al. 2005, Williams et al. 2011, Williams et al. 2016). Extant populations can still be found in all major river basins within the ESU (70 FR 37160; June 28, 2005). However, extirpations, loss of brood years, and sharp declines in abundance (in some cases to zero) of SONCC coho salmon in several streams throughout the ESU indicate that the SONCC coho salmon's spatial structure is more fragmented at the population-level than at the ESU scale. The genetic and life history diversity of populations of SONCC coho salmon is likely very low and is inadequate to contribute to a viable ESU, given the significant reductions in abundance and distribution. The SONCC coho salmon ESU is currently considered likely to become endangered within the foreseeable future in all or a significant portion of its range. Of particular concern is the low number of adults counted entering the Shasta River in 2014-15. The lack of increasing abundance trends across the ESU for the populations with adequate data are of concern. Moreover, the loss of population spatial scale estimates from coastal Oregon populations is of great concern. The new information since Williams et al. (2011) while cause for concern, does not appear to suggest a change in extinction risk at this time (NMFS 2016b).

2.2.2.2 *Status of Central Valley Steelhead*

California Central Valley (CV) steelhead exhibit a similar life history to CV spring-run Chinook and occupy a similar geographic range. Spawning occurs in a number of tributaries to the Sacramento River, to which the Delta and Sacramento River serve as key migratory corridors (NMFS 2014b). Spawning occurs from December to April, with a peak in January through March, in rivers and streams where cold, well-oxygenated water is available (Hallock et al. 1961; McEwan and Jackson 1996; Williams 2006). Adults typically spend a few months in freshwater before spawning (Williams 2006). Juvenile CV steelhead rear in cool, clear, fast-flowing streams and are known to prefer riffle habitat over slower-moving pools (NMFS 2014b). The Sacramento River is likely used primarily as a migratory corridor.

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

The Central Valley domain Technical Recovery Team identified more than 80 populations of Central Valley steelhead, many of which are located above barriers and may persist as non-anadromous rainbow trout. Lindley et al. (2007) found that data were insufficient to determine the viability of any of the naturally spawning populations of Central Valley steelhead, except for those spawning in rivers adjacent to hatcheries, which were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas (Williams et al. 2016).

The viability of the overall CV Steelhead DPS appears to have slightly improved since the 2010 assessment, when it was concluded that the DPS was in danger of extinction. This modest improvement is driven by the increase in adult returns to hatcheries from their recent lows, but the state of naturally produced fish remains poor. Improvements to the total population sizes of the three previously evaluated steelhead populations (Battle Creek, Coleman National Fish Hatchery, and Feather River Hatchery) does not warrant a downgrading of the ESU extinction risk. In fact, the lack of improved natural production as estimated by samples taken at Chipps Island, and low abundances coupled with large hatchery influence in the Southern Sierra Nevada Diversity group is cause for concern. As in the previous assessments (Good et al. 2005; Williams et al. 2011), the CV steelhead DPS continues be at a high risk of extinction (Williams et al. 2016).

Although steelhead will experience similar effects of climate change to spring run Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat, the effects may be even greater in some cases, as juvenile steelhead may rear in freshwater over the summer prior to emigrating as smolts (Snider and Titus 2000). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than salmon (McCullough et al. 2001). McCullough et al. (2001) recommended an optimal incubation temperature at or below 11°C to 13°C (52°F to 55°F), and successful smoltification in steelhead may be impaired by temperatures above 12°C (54°F) (Richter and Kolmes 2005). In some areas, stream temperatures that currently provide marginal habitat for spawning and rearing may become too warm to support naturally spawning steelhead populations in the future.

2.2.2.3 Status of Sacramento River winter-run Chinook salmon

Historically, winter-run population estimates were as high as 120,000 fish in the 1960s, but declined to less than 200 fish by the 1990s (NMFS 2011c). Since carcass surveys began in 2001, the highest adult escapement occurred in 2005 and 2006 with 15,839 and 17,296, respectively. However, from 2007 to 2013, the population has shown a precipitous decline, averaging 2,486 during this period, with a low of 827 adults in 2011. This declining trend is likely due to a combination of factors such as poor ocean productivity (Lindley et al. 2009), drought conditions from 2007- 2009, and low in-river survival (NMFS 2011c).

The greatest risk factor for the winter-run lies within its spatial structure (NMFS 2011c). The remnant and remaining population cannot access 95 percent of their historical spawning habitat, and must therefore be artificially maintained in the Sacramento River by: (1) spawning gravel augmentation, (2) hatchery supplementation, and (3) regulating the finite cold-water pool behind Shasta Dam to reduce water temperatures. Winter-run require cold water temperatures in the summer that simulate their upper basin habitat, and they are more likely to be exposed to the impacts of drought in a lower basin environment. Battle Creek is currently the most feasible opportunity for the ESU to expand its spatial structure, but restoration is not scheduled to be completed until 2020. The Central Valley Salmon and Steelhead Recovery Plan includes criteria for recovering the winter-run Chinook salmon ESU, including re-establishing a population into historical habitats upstream of Shasta Dam (NMFS 2014b). Additionally, NMFS (2009a) included a requirement for a pilot fish passage program above Shasta Dam.

The current winter-run population is the result of the introgression of several stocks (e.g., spring-run and fall-run Chinook) that occurred when Shasta Dam blocked access to the upper watershed. A second genetic bottleneck occurred with the construction of Keswick Dam which blocked access and did not allow spatial separation of the different runs (Good et al. 2005). Lindley et al. (2007) recommended reclassifying the winter-run population extinction risk from low to moderate, if the proportion of hatchery origin fish from the Livingston Stone National Fish Hatchery (LSNFH) exceeded 15 percent due to the impacts of hatchery fish over multiple generations of spawners. Since 2005, the percentage of hatchery-origin winter-run recovered in the Sacramento River has only been above 15 percent in two years, 2005 and 2012.

There are several criteria that would qualify the winter-run ESU at moderate risk of extinction, and since there is still only one population that spawns below Keswick Dam, that population would be at high risk of extinction in the long-term according the criteria in (Lindley et al. 2007). Recent trends in those criteria are: (1) continued low abundance; (2) a negative growth rate over 6 years (2006–2012), which is two complete generations; (3) a significant rate of decline since 2006; and (4) increased risk of catastrophe from oil spills, wild fires, or extended drought (climate change). In summary, the most recent biological information suggests that the extinction risk for the winter-run ESU has increased from moderate risk to high risk of extinction since 2005, and that several listing factors have contributed to the recent decline, including drought and poor ocean conditions (NMFS 2016c).

The overall viability of Sacramento River Winter-run Chinook salmon has declined since the 2010 viability assessment, with the single spawning population on the mainstem Sacramento River. The larger influence of hatchery broodstock in addition to the rate of decline in abundance over the past decade has placed the population at an increased risk of extinction (Williams et al. 2016).

2.2.2.4 Status of Central Valley spring-run Chinook salmon

The Sacramento River is included in the action area and is extensively used by various life stages of the Central Valley spring-run Chinook salmon ESU. Adult spring-run Chinook salmon enter the Sacramento River between March and September, primarily in May and June (Yoshiyama et al. 1998; Moyle 2002).

Monitoring of the Sacramento River mainstem during spring-run Chinook salmon spawning indicates that some spawning occurs in the river. Although physical habitat conditions in the accessible upper Sacramento River can support spring-run Chinook salmon spawning and incubation, significant hybridization/introgression with fall-run Chinook salmon due to lack of spatial/temporal separation makes identification of spring-run Chinook salmon in the mainstem very difficult (CDFG 1998). Counts of Chinook salmon redds in the uppermost portion of the Sacramento River mainstem are typically used as an indicator of the Sacramento River spring-run Chinook salmon population abundance. Fewer than fifteen Chinook salmon redds per year were observed in the Sacramento River from 1989 to 1993 based on September aerial redd counts. Redd surveys conducted in September between 2001 and 2011 have observed an average of 36 Chinook salmon redds from Keswick Dam downstream to the Red Bluff Diversion Dam (RBDD), ranging from 3 to 105 redds; from 2012 to 2015, close to zero redds were observed, except in 2013, when 57 redds were observed in September (CDFW 2015).

Currently, the majority of returning adult spring-run Chinook salmon spawn in the tributaries to the Sacramento River. The upper Sacramento River mainly functions as both rearing habitat for juveniles and the primary migratory corridor for outmigrating juveniles and spawning adults for all the Sacramento River basin populations. Due to introgression in the mainstem, the populations in Butte, Deer and Mill creeks are considered to be better representative indicators for ESU viability.

According to the NMFS 5-year species status review (NMFS 2016b), the status of the CV spring-run Chinook salmon ESU, until 2015, has improved since the 2010 5-year species status review. The improved status is due to extensive restoration, and increases in spatial structure with historically extirpated populations (Battle and Clear creeks) trending in the positive direction. Recent declines of many of the dependent populations, high pre-spawn and egg mortality during the 2012 to 2016 drought, uncertain juvenile survival during the drought are likely increasing the ESU's extinction risk. Monitoring data showed sharp declines in adult returns from 2014 through 2018 (CDFW 2018).

Spring-run Chinook salmon adults are vulnerable to climate change because they over-summer in freshwater streams before spawning in autumn (Thompson et al. 2011). Spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and without cold water refugia (usually input from springs), those tributaries will be more susceptible to impacts of climate change. Even in tributaries with cool water springs, in years of extended drought and warming water temperatures, unsuitable conditions may occur. Additionally, juveniles often rear in their natal stream over the summer prior to emigrating (McReynolds et al. 2007) and would be susceptible to warming water temperatures.

2.2.2.5 Status of Critical Habitats

The condition of SONCC coho salmon, Central Valley steelhead, Sacramento River winter-run Chinook salmon, and Central Valley spring-run Chinook 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: logging, agriculture, mining, urbanization, stream channelization, dams, wetland loss, and water withdrawals (including unscreened diversions for irrigation). Impacts of concern include altered stream bank and channel morphology, elevated water temperature, lost spawning and rearing habitat, habitat fragmentation, impaired gravel and wood recruitment from upstream sources, degraded water quality, lost riparian vegetation, and increased erosion into streams from upland areas. Diversion and storage of river and stream flow has dramatically altered the natural hydrologic cycle in many of the streams within the ESUs and DPS (NMFS 2016a, b, c, f). Altered flow regimes can delay or preclude migration, dewater aquatic habitat, and strand fish in disconnected pools, while unscreened diversions can entrain juvenile fish.

2.2.3 Factors Responsible for the Decline of Species and Degradation of Critical Habitats

The factors that caused declines of species and degradation of critical habitats include hatchery practices, ocean conditions, habitat loss due to dam building, degradation of freshwater habitats due to a variety of agricultural and forestry practices, water diversions, urbanization, over-fishing, mining, climate change, and severe flood events exacerbated by land use practices (Good et al. 2005, Williams et al. 2016). Sedimentation and loss of spawning gravels associated with poor forestry practices and road building are particularly chronic problems that can reduce the productivity of salmonid populations. Late 1980s and early 1990s droughts and unfavorable ocean conditions were identified as further likely causes of decreased abundance (Good et al. 2005). From 2014 through 2016, the drought in California reduced stream flows and increased temperatures, further exacerbating stress and disease. Ocean conditions have been unfavorable in recent years (2014 to present) due to the El Nino in 2015 and 2016. Reduced flows can cause increases in water temperature, resulting in increased heat stress to fish and thermal barriers to migration.

Information since these species were listed suggests that the earth's climate is warming, and that this change could significantly impact ocean and freshwater habitat conditions, which affect survival of species subject to this consultation. In the coming years, climate change will influence the ability to recover coho and Chinook salmon in most or all of their watersheds. Steelhead are particularly vulnerable to climate change due to their need for year-round cool water temperatures (Moyle 2002). Through effects on air temperatures and stream flows, climate change is expected to increase water temperatures to the detriment of salmonids. Climate change effects on stream temperatures within Northern California are already apparent. For example, in the Klamath River, Bartholow (2005) observed a 0.5°C per decade increase in water temperature since the early 1960s, and model simulations predict a further increase of 1-2°C over the next 50 years (Perry et al. 2011).

In coastal and estuarine ecosystems, the threats from climate change largely come in the form of sea level rise and the loss of coastal wetlands. Sea levels will likely rise exponentially over the next 100 years, with a 61-110 cm rise possible by the end of the 21st century (IPCC 2019; RCP 8.5 model). This rise in sea level will alter the habitat in estuaries and either provides an increased opportunity for feeding and growth or in some cases will lead to the loss of estuarine habitat and a decreased potential for estuarine rearing of salmonids. Marine ecosystems face an entirely unique set of stressors related to global climate change, all of which may have deleterious impacts on growth and survival while at sea. In general, the effects of changing climate on marine ecosystems are not well understood given the high degree of complexity and the overlapping climatic shifts that are already in place (e.g., El Niño, La Niña, Pacific Decadal Oscillation) and will interact with global climate changes in unknown and unpredictable ways. Overall, climate change is believed to represent a growing threat, and will challenge the resilience of listed salmonids in Northern California.

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).

For the purposes of this consultation, the action area encompasses specific sites that will be maintained or improved under the Fish Habitat and Passage Program and 300 feet up and downstream of work activity, including the stream banks and channel to account for suspended sediment generated from in-water activity and any disturbance from equipment and personnel. The action area therefore is relatively disbursed in relatively short sections of various river and streams in Siskiyou, Trinity, Tehama, and Shasta counties. Streams contained in Siskiyou County include: Beaver Creek, Coon Creek, Shasta River, Shovel Creek, Horse Creek, Cold Creek, Bogus Creek, Little Shasta River, Parks Creek, Negro Creek, Shackleford Creek, French Creek, Middle Creek, Horse Creek, Cottonwood Creek, Mill Creek, Etna Creek, Grider Creek, Kidder Creek, Patterson, Buckhorn Creek, Cold Creek, East Fork Scott River, Scott River, Little Castle Creek, and Shotgun Creek. Streams in Trinity County include: Grass Valley Creek, West Weaver Creek, Soldier Creek, Carr Creek, Hayfork Creek, Rusch Creek, Big Creek, Tule Creek, West Tule Creek, Prairie Creek, Little French Creek, Swede Creek, Don Juan Creek, Barker Creek, Wilson Creek, Goods Creek, Kingbury Gulch Creek, and Devil's Gulch Creek. Tehama County streams include: Antelope Creek, Battle Creek, Mill Creek, and Deer Creek. Shasta County streams include: North Cow Creek, Battle Creek, and Salt Creek.

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).

2.4.1 Status of Species in the Action Area

Impacts from project activities are likely to manifest in relatively confined areas near each maintenance site. These sites are widespread but not necessarily located throughout the entire ESU or DPS for a given species. For instance, no project activities will take place within the South Fork Trinity Basin, and SONCC coho salmon will not experience any project effects in this area. Similarly, no work activities and possible effects to species will occur in the Lower Klamath River or Sacramento River below Deer Creek. Greater detail on listed species status for specific streams within the action area is provided below.

Status of SONCC Coho Salmon in the Action Area

The action area within the distribution of the SONCC coho salmon consists of the following population units: Upper Klamath River, Middle Klamath River, Shasta River, Scott River, Upper Trinity River, and the Lower Trinity River.

Upper Klamath River
SONCC coho salmon are the only ESA-listed salmonid occurring in the Klamath River basin. Coho salmon within the Upper Klamath River population spawn and rear primarily within several of the larger tributaries between Portuguese Creek and Iron Gate Dam. Coho salmon presence was confirmed in six surveyed tributary streams in or near the action area, including Horse, Seiad, Grider, and West Grider, creeks (Garwood 2012). Since 2014 the total number of adult coho salmon observed by CDFW in Bogus Creek has been less than 100 fish, and the numbers appear to be decreasing over time (Knechtle and Giudice 2018). Using a variety of methods including weirs, traps, and tributary spawning surveys, and an Intrinsic Potential (IP) database, Ackerman et al. (2006) estimated the abundance of coho salmon in the entire Upper Klamath River population to be between 100 to 4,000 adults, far lower than the 8,500 spawners needed for this population to achieve a low extinction risk (Williams et al. 2008). The Upper Klamath River population is at a high risk of extinction given its low population size and negative population growth rate. In addition, habitat is often not fully occupied, such that the high risk criteria described by Williams et al (2008) are met or exceeded.

Middle Klamath River
Little data on adult coho are available for this stretch of river. Adult spawning surveys and snorkel surveys have been conducted by the U.S. Forest Service and Karuk Tribe, but data from those efforts are insufficient to draw definitive conclusions on run sizes (Ackerman et al. 2006). Ackerman et al. (2006) relied on professional judgment of local biologists to determine what run sizes would be in high, moderate, and low return years to these tributaries; therefore, the run size approximations are judgment based estimates. While these run size approximations indicate that the Middle Klamath River population may be above the spawners required for ESU viability

threshold in some years, NMFS (2014b) does identify that the Middle Klamath River population is at moderate risk of extinction. Adults and juveniles appear to be well distributed throughout the Middle Klamath; however, use of some spawning and rearing areas is restricted by water quality, flow, and sediment issues. Although its spatial distribution appears to be good, many of the Middle Klamath tributaries are used for non-natal rearing, and too little is known to infer its extinction risk based on spatial structure.

Shasta River
Adult coho salmon returns to the Shasta River have generally been in decline over the last decade. Since 2007, the number of adult coho observed entering the Shasta River has ranged from a high of 249 fish in 2007 to a low of only 9 fish in 2009 (Giudice and Knechtle 2018). To reduce the risk of demographic extinction all Iron Gate Hatchery (IGH), surplus adult coho salmon have been released back to the Klamath River since 2010. Some of these surplus adults have been observed entering the Shasta River which is about 14 river miles downstream from IGH. Since that time, the percentage of hatchery origin coho salmon observed in the Shasta River spawning population has ranged from about 25 percent to 80 percent. Due to the low demographics of the Shasta River population, IGH origin fish play an important role in increasing the likelihood that wild/natural coho salmon find a mate and successfully reproduce. The portion of hatchery origin adults in the spawning population is unknown for the most recent three years (2015 to 2017) because sampling efforts were unable to recover any adult carcasses during this time. The Shasta River population is at high risk of extinction given the low and unstable population, and because the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in the Shasta River watershed is less than one, the criterion described by Williams et al. (2008).

Scott River
Abundance estimates on the Scott River are also relatively robust due to the installation of a video fish counting weir in 2007 (Knechtle and Giudice 2018). In 2016 and 2017, 250 and 368 adult coho salmon were estimated to have returned to the river, respectively. Spawning activity and redds have been observed in the East Fork Scott River, South Fork Scott River, Sugar, French, Miners, Etna, Kidder, Patterson, Shackleford, Mill, Canyon, Kelsey, Tompkins, and Scott Bar Mill creeks.

Fish surveys conducted since 2001 on the Scott River and its tributaries have documented that many tributaries do not consistently sustain juvenile coho salmon, indicating that the spatial structure and diversity of this population is restricted by available rearing habitat. Many of these tributaries likely have intermittent fish occupation due to low flow barriers for juvenile and adult migration. Juvenile fish have been found rearing in the mainstem Scott River, East Fork Scott River, South Fork Scott River, Shackleford Creek and its tributary Mill Creek, Etna Creek, French Creek and its tributary Miners Creek, Sugar Creek, Patterson Creek, Kidder Creek, Canyon Creek, Kelsey Creek, Tompkins Creek, and Mill Creek (NMFS 2014a). The Scott River population is at moderate risk of extinction because the ratio of the three consecutive years of lowest abundance within the last twelve years to the amount of IP-km in a watershed is greater than one, but the ratio is less than the minimum required spawner density (both criteria described in Williams et al. 2008).

Trinity Basin
Information regarding population size of individual SONCC coho salmon population units in the Trinity Basin is limited because no systematic monitoring is conducted on any of the coho salmon populations in the area. Because adult coho salmon from all three population units of the Interior-Trinity Diversity Stratum pass through the Willow Creek weir on the lower Trinity, it is not known which population of coho Salmon is captured at the weir. As such, the weir provides an aggregate population estimate for all unmarked coho salmon upstream of the weir. All coho salmon marked by right maxillary bone removal captured at the weir are known to be of Trinity River Hatchery (TRH) origin. The California drought from 2013 to 2017, combined with poor ocean conditions during the same period pushed adult coho salmon returns to some of their lowest levels in recent decades. Hatchery origin adults often make up 80% or greater of the overall run, though there is indication that this proportion has decreased recently with lower production from TRH.

The Upper Trinity River population is at moderate risk of extinction as described in the SONCC coho salmon recovery plan (NMFS 2014a). Coho salmon continue to be present in many of the tributary streams in this population unit, but low adult returns in recent years have left some habitat unoccupied. Although there may be robust numbers of spawners occasionally in some years, the overall number of naturally produced coho salmon in the Upper Trinity River watershed is low compared to historic conditions, and hatchery fish dominate the run. The Upper Trinity River Population unit has the greatest degree of temporal and spatial exposure to hatchery fish of any of the population units in the action area. SONCC coho salmon in this population unit are exposed to both genetic interactions through breeding with TRH coho salmon, as well as ecological interactions (predation, competition and disease transfer) with hatchery coho salmon, Chinook salmon, and steelhead.

Limited data exists for the Lower Trinity population as few surveys have been completed. The limited data available from the U.S. Forest Service and the Hoopa Valley Tribe for the Lower Trinity River population suggests that much of the habitat in the Lower Trinity River is currently unoccupied or only sporadically occupied (NMFS 2019). Brood year cohorts may be missing and the adult coho salmon population is likely less than the depensation threshold of 112 adults. The Lower Trinity population is at high risk of extinction as described in the SONCC coho salmon recovery plan (NMFS 2014a).

Status of Central Valley Spring-run Chinook in the Action Area

Spring-run Chinook salmon use Mill, Deer, and Battle creeks for holding, spawning, and rearing. Maintenance activities will take place in these watersheds and these three streams contain key source populations for spring-run Chinook. Rotary screw trap data (Johnson and Merrick 2012) on Deer Creek has indicated a large reduction in yearling and young-of-the-year outmigration timing relative to when screen and ladder cleaning activities largely take place. Juvenile outmigrants from Mill Creek exhibit similar long emergence timing (CDFW 2019) and reduced occurrence in the action area during work activities. The Battle Creek adult monitoring program has seen some troublesome trends continuing in the watershed, in combination with the lowest spring Chinook population estimate since the program started 23 years ago. Since 2013, FWS identified lower than average redd counts compared to the total adult Chinook in Battle Creek

(CDFW 2019). In the past five years, these numbers have ranged from 31% to 57% of the population successfully spawning with this year only 33% of the population making it to spawn. The proportion of hatchery fish making up our spawning population has varied over the years and has ranged from 4% in 2009 to 29% in 2010. This year hatchery fish accounted for 7% of the total spawning population. The majority of these fish are believed to be of Feather River Fish Hatchery-origin based on coded wire tag data collected from snorkel surveys (CDFW 2019).

Status of California Central Valley Steelhead in the Action Area

Adult CV steelhead are not anticipated to use project sites for spawning (CDFW 2019), with the exception of the upper diversion on Battle Creek and Lower Deer Creek Falls on Deer Creek. The Upper Sacramento River Basin Fisheries Program currently estimates populations of natural-origin adult steelhead returning to seven upper Sacramento River tributaries (Eilers et al. 2010, Killam and Mache 2018). These tributaries include Cow, Cottonwood, Clear, Bear, Antelope, Deer, and Mill creeks. On Cow, Paynes, Antelope and Salt Creek, the period of migration later into the spring is even more truncated as these streams become warmer earlier than Battle, Mill, or Deer, Creeks (WSRCD and CCWMG 2001, WSRCD 2005, and RCDTC 2010), which may prohibit juvenile fish from migrating out to the Sacramento River. Ultimately, these data show an overlap with outmigration and the onset of project activity, the majority of which starts in April with some sites maintained in February and March. However, a good portion of any outmigration of fry is done before the diversion season starts.

Natural-origin CV steelhead have continued to decrease in abundance and in the proportion to hatchery-origin fish over the past 25 years in the action area (NMFS 2016a); the long-term trend remains negative. Most of the steelhead populations in the Central Valley have a high hatchery component, including Battle Creek where adults are intercepted at the CNFH weir (NMFS 2016a). Hatchery-origin production and returns are dominant over natural-origin fish. Natural-origin CV steelhead populations in the action area are small and may lack the resiliency to persist for protracted periods if subjected to additional stressors. The genetic diversity of CV steelhead has likely been impacted by low population sizes and high proportion of hatchery-origin to natural-origin fish (NMFS 2016a).

Status of Sacramento River Winter-run Chinook in the Action Area

Battle Creek is the only stream within the project area where winter-run Chinook salmon may be exposed to work activities. Battle Creek presents a reasonable option for reestablishment of an independent population because the Battle Creek Salmon and Steelhead Restoration Project (BCRP) (USBR 2008) is expected to restore unencumbered access to quality spring-fed spawning habitat in NF Battle Creek by 2021 (ICF International 2016). When completed, the BCRP will provide passage by either removing facilities or providing passage over manmade and natural barriers in the system, augmenting flows within the North and South Forks of Battle Creek and disconnecting the conveyance of water from the North Fork to the South Fork of Battle Creek. Upon completion of the BCRP, access to approximately 48 miles of spawning and rearing habitat is expected to be restored in the Battle Creek watershed for the assemblage of salmonids that inhabited Battle Creek historically. Twenty-five miles of this habitat will be in the North Fork, of which 10 to 12 miles is expected to be suitable for winter-run Chinook salmon spawning and incubation of winter-run Chinook salmon eggs (ICF International 2016).

As part of the winter-run Chinook salmon Reintroduction Program on Battle Creek (ICF International 2016), 214,000 juvenile winter-run Chinook were released into Battle Creek in 2018 as part of the "jump start" program portion of the program aimed at bolstering the endangered fish's population after extreme drought in 2014 and 2015 nearly wiped out the entire in-river juvenile population. On May 5, 2019, the first confirmed fish from this group of released fish returned to Battle Creek, was captured at the CNFH and was subsequently brought to the Livingston Stone Hatchery near Shasta Reservoir. From May 5 to July 17, 2019, 75 jacks were intercepted at CNFH and transferred to LSNFH, and these fish were incorporated into the broodstock for brood year 19 jumpstart fish (CDFW 2019).

2.4.2 Status of Critical Habitats in the Action Area

Similar to species effects, possible impacts from project activity to critical habitat are likely to manifest in relatively confined areas near each maintenance site. These sites are widespread but not necessarily located throughout the entire DPS of each species. No project activities will take place within the South Fork Trinity Basin and SONCC coho salmon critical habitat will not experience any project effects in this area. No work activities and possible effects to habitat will occur in the Lower Klamath River or Sacramento River below Deer Creek. For all listed species considered, more detailed information on critical habitat status is required for watersheds containing the action area and is provided below.

Although expected to be exceedingly rare and short lived, some screen structures may be overtopped or damaged by unusually high flows which may result in the entrainment of juveniles and adults into diversion ditches throughout the action area. There is no current mitigation for this possibility but such events are likely to occur only on an extremely limited basis and the possibility of entrainment is further reduced during these rare events by the tendency of salmonids to seek low velocity refuge during over-bank flows and CDFW's frequent inspection and repair of impacted diversions. Creating a structure to prevent overtopping is not feasible as high flows will likely inundate a large area, not just the screen itself, and a massive structure would be needed to isolate fish from the floodplain.

Status of SONCC Coho Salmon Critical Habitat in the Action Area

Critical habitat for SONCC coho is contained within the proposed action area. PBFs for coho are concurrently defined in (64 FR 24049; May 5, 1999) and the following PBFs, in summary, for SONCC coho are present in the proposed action area: (1) freshwater spawning sites, (2) freshwater rearing sites, and (3) freshwater migration corridors.

Upper Klamath River

The Klamath River originates at Upper Klamath Lake in the State of Oregon, and has six dams which provide hydropower, irrigation, and regulation of stream flow as well as Upper Klamath Lake levels. Flows downstream of Iron Gate Dam basin are reduced and altered seasonally due to water management along the upper reaches. Although anadromous fish passage is currently blocked at Iron Gate Dam, coho salmon once populated the basin at least to the vicinity of and including Spencer Creek at river mile (RM) 228 (Hamilton et al. 2005). Today, SONCC coho salmon occupy a small fraction of their historical area (National Research Council [NRC] 2004). Dams block access to approximately 76 miles of spawning, rearing, and migratory habitat for coho salmon (NMFS 2014a). The most prevalent key limiting threats affecting the basin are dams/diversions and agricultural practices (NMFS 2014a).

Poor water quality conditions in the Klamath River during the summer have been recognized as a major contributing factor to the decline of anadromous fish runs (Bartholow 1995). The main causative factor driving poor water quality conditions in the mainstem Klamath is large-scale water impoundment and diversion above Iron Gate Dam. Average annual flow below Iron Gate Dam has declined by more than 370,000 acre-feet since inception of the Bureau of Reclamation's Klamath Project (NRC 2003). The large volume of diverted water significantly affects aquatic habitat. Project operations tend to increase flows in October and November, and decrease flows in the late spring and summer as measured throughout the Klamath mainstem (Hecht and Kamman 1996). Low summer flow volumes within the Klamath River can increase daily maximum water temperatures during critical summer months by slowing flow transit rates and increasing thermal loading when compared to higher flow levels (Deas and Orlob 1999). The present temperature regime in the mainstem Klamath River Basin is often near the upper limits for salmonid adults in July through September and for rearing juveniles May through October (Dunne et al. 2011).

Moreover, further heating the already-warm, nutrient-rich water released from Iron Gate Dam typically results in poor water quality conditions in the Klamath River between the dam and Seiad Valley. Increased water temperatures, elevated nutrient levels, low dissolved oxygen concentrations, elevated pH, and high concentrations of potentially toxinogenic blue-green algae decrease the quality and quantity of suitable habitat for fish and aquatic life (NCRWQCB 2010). The entire Klamath River and its tributaries are currently listed as impaired under section 303 (d) of the Clean Water Act as outlined in the Klamath River Total Maximum Daily Load (TMDL) for temperature, nutrients, dissolved oxygen, and Microcystin (NCRWQCB 2010).

In addition to borderline temperatures and poor water quality, salmonids must contend with the myxozoan parasite *Ceratonova shasta*. For the past decade, ceratomyxosis (enteronecrosis) has been regarded as the major cause of mortality in coho salmon (Foott et al. 2002; Fujiwara et al. 2011). *Ceratonova shasta*, which is present throughout the Pacific Northwest, but its negative impacts on native salmonids are most thoroughly documented in the Klamath River. Low flows and higher than average river temperatures can create habitat conditions that are more favorable to *C. shasta* transmission. Concentration of the parasite infectious spore stage in reduced volumes of water result in higher infectious inoculation of the fish host (True et al. 2015).

Agriculture activities have also degraded water quality through reductions in flow, increases in nutrient inputs, and increased water temperatures throughout the Klamath Basin. Agriculture runoff contributes nitrates and phosphates into local waterways. Lower summer flows emanating from the Klamath Project (i.e., released at Iron Gate Dam) are exacerbated by diminished inflow from many of the major tributaries to the middle Klamath River. The Shasta and Scott rivers historically supported strong populations of salmonids, including coho salmon (KRBFTF 1991). However, seasonal withdrawals for agriculture in the spring and summer months can drop stream flows by more than 100 cubic feet per second (cfs) over a 24 hour period, contributing to a general increase in stream temperatures (Debrick et al. 2015) and potentially stranding juvenile salmonids.

Middle Klamath River

Similar to the mainstem portion of the Upper Klamath River reach, low flows during the spring can slow the emigration of coho salmon smolt, which can in turn lead to longer exposure times for disease, and greater risk of predation. In part due to this concern, flow releases to increase the volume of water in the Middle Klamath Reach were incorporated into the NMFS opinion (NMFS 2019). Higher velocities resulting from these flow releases have somewhat addressed the water quality concern by reducing "dead zones" within the channel that can harbor disease pathogens (Hardy et al. 2006), thereby reducing the overall impact of disease infection on coho salmon. Still, summer water diversions downstream of IGD, which further decrease flows, contribute to degraded habitat and/or fish passage issues at tributaries such as Stanshaw, Red Cap, Boise, Camp, Elk Creek, and Fort Goff creeks during low water years.

Implementation of the flows analyzed in the NMFS and FWS (2013) joint opinion has likely alleviated many of the adult migration issues observed in the past and improved critical habitat in the Middle Klamath reach. Implemented flows include fall and winter flow variability, which has alleviated instream conditions brought about by low flows that likely resulted in impairments to upstream adult migration in the past.

Juvenile summer rearing areas in this reach are degraded relative to the historic state. High water temperatures, exacerbated by water diversions and seasonal low flows, restrict juvenile rearing in the mainstem Klamath River and lessen the quality of tributary rearing habitat (NMFS 2014b). Nevertheless, a few tributaries within the Middle Klamath River Population (e.g., Boise, Red Cap and Indian creeks) support populations of coho salmon, and offer critical cool water refugia within their lower reaches when mainstem temperatures and water quality approach uninhabitable levels. Other important tributaries for juvenile rearing include Sandy Bar, Stanshaw, China, Little Horse, Pearch, and Boise creeks (NMFS 2014b). However, these cool water tributary reaches can become inaccessible to juveniles when low flows and sediment accretion create passage barriers; therefore, summer rearing habitat can be limited.

The quality and amount of spawning habitat in the Middle Klamath River reach is naturally limited due to the geomorphology and the prevalence of bedrock. Coho salmon are typically tributary and headwater stream spawners, so it's unclear if there was historically very much mainstem spawning in this reach.

Shasta River

The hydrology of the Shasta River has been and continues to be affected by Dwinnell Dam, surface water diversions, and interconnected groundwater pumping. The construction of Dwinnell Dam and the Parks Creek diversion by the Montague Water Conservation District in about 1926 has altered the natural flow and sediment transport regime in both the upper Shasta River and lower Parks Creek and also blocked access to about 22 percent of the available fish habitat for anadromous salmonids (NRC 2004). The loss of spawning gravel, woody debris, pools, side channels, springs, and accessible wetlands from land use conversions, have also contributed to reduced summer and winter rearing capacity for juvenile coho salmon. Further alterations to stream channel function from agricultural practices includes irrigation tailwater returns, damage to riparian habitat from livestock grazing and a reduction in the number of beaver ponds, which provide important habitat attractive to rearing coho salmon.

The Shasta River, as with other locations in the action area, has an extensive history of gold mining with remnant mine tailing piles and altered channel morphology still present along the banks of the river from activities that occurred from the 1850s through the 1930s. Large dredge mining activities ended around 1950 in the Shasta Basin; including in Yreka Creek, but riparian area remain poorly vegetated and erodible in these sites (Shasta Valley Resource Conservation District 2005, as cited in NMFS 2014a) These past operations continue to be a threat for coho salmon critical habitat along the west side of the Shasta Basin through legacy effects of remnant tailing piles, altered channel morphology, and potential remaining gold mining-associated pollution inputs.

Scott River

A number of physical fish barriers exist in the Scott River watershed. For instance, Big Mill Creek, a tributary to the East Fork Scott River, has a complete fish passage barrier caused by down cutting at a road culvert outfall. Additionally, historical mining has left miles of tailing piles along the mainstem and some tributaries of the Scott River. A seven mile reach of Scott River goes subsurface every summer due to this channel modification in combination with low flows, limiting juvenile redistribution. For example, during the summer of 2014 when flows were disconnected in the mainstem Scott River, large numbers of juvenile coho salmon were left stranded, unable to migrate to suitable rearing habitat. A large rescue-relocation effort led to 115,999 coho salmon being moved to cold water habitats; however, monitoring of this effort showed that relocation did not increase the survival of rescued fish (CDFW 2016). For many years, the City of Etna's municipal water diversion dam on Etna Creek effectively blocked fish passage into upper Etna Creek; however, this dam was retrofitted with a volitional fishway in 2010. In addition, valley-wide agricultural surface water withdrawals and diversions, and groundwater extraction have all combined to cause premature surface flow disconnection in the summer and delayed re-connection in the fall along the mainstem Scott River. These conditions can consistently result in restrictions or exclusions to suitable rearing habitat, contribute to elevated water temperatures, and contribute to conditions which cause juvenile fish stranding and mortality.

Trinity River

The Trinity River Division of the Central Valley Project has caused loss of hydraulic function, habitat loss, and habitat simplification in the mainstem Trinity River. The juvenile stage of the Upper Trinity River population unit of SONCC coho salmon is the most limited life stage and suitable quality summer and winter rearing habitat is lacking for the population. Loss of flow variability and reduced rearing habitat during the fall and winter months as a result of truncated flow release is expected to reduce the ability of the habitat in the Upper Trinity River to support winter rearing of juvenile coho salmon. Water withdrawals from important tributaries like Weaver and Rush creeks reduce baseflows in the summer and fall months, contributing to low flows and high water temperatures. Variability of the natural flow regime is inherently critical to ecosystem function and native biodiversity (Bunn and Arthington 2002, Beechie et al. 2006). In the summer, flow regimes and the lack of large woody debris (LWD) and off-channel habitat leads to poor hydrologic function, disconnection and diminishment of thermal refugia, and poor water quality in tributaries and the mainstem during dry years. These issues are being addressed through restoration efforts but will continue to persist as limiting factors for the population.

Lack of floodplain and channel structure impacts has a major impact on the productivity of the Lower Trinity River population. Rearing opportunities and capacity are low due to disconnection of the floodplain, a lack of LWD inputs, poor riparian conditions, and sediment accretion. Low-lying areas of streams such as Supply, Mill, and Willow Creek have been channelized, diked, and disconnected from the floodplain. Many tributaries in low-gradient areas of the Lower Trinity experience similar habitat characteristics due to development of the floodplain, sedimentation and changes in flow. The mainstem also lacks side channel, backwater, and wetland habitat where juvenile coho salmon could find habitat in the winter. A lack of floodplain and channel structure impacts winter rearing because high flow events can displace juveniles from streams and there exists very little low-velocity rearing habitat. Lack of complex habitat also impacts summer rearing due to the loss of predatory refugia, low-flow refugia, and foraging habitat. In some portions of this population unit cannabis farming impacts summer rearing areas for juveniles, due to runoff and pollution, as well as contributing to poor water quality and quantity. Note, there is no critical habitat on the Hoopa Valley Tribe Reservation, which is located in the lower Trinity River area.

Status of Central Valley Spring-run Chinook Salmon and California Central Valley Steelhead Critical Habitats in the Action Area

Critical habitat for both CV spring-run Chinook salmon and CV steelhead is contained within the proposed action area. PBFs for both species are concurrently defined in (70 FR 52488; September 2, 2005) and the following PBFs, in summary, for these species are present in the proposed action area: (1) freshwater spawning sites, (2) freshwater rearing sites, and (3) freshwater migration corridors.

The Sacramento River originates near Mt. Shasta, and flows south for 447 miles before reaching the Sacramento–San Joaquin River Delta and San Francisco Bay. Shasta Dam, which is located at RM 311 on the Sacramento River near Redding, California, was completed in 1945. Keswick Dam (RM 302) was constructed nine miles downstream from Shasta Dam to create a 23,800 acre-foot afterbay for Shasta Lake and the Trinity River Division, which stabilizes uneven water releases from the powerplants. Below Keswick Dam, the Anderson-Cottonwood Irrigation District Diversion Dam (ACID Dam; RM 297) is seasonally in place to raise the water level for diversions into the ACID canal. The 59 mile reach of the Sacramento River between Keswick Dam and RBDD is commonly referred to as the Upper Sacramento River. Shasta and Keswick dams have presented impassable barriers to anadromous fish since 1943 (Moffett 1949 as cited in Poytress et al. 2014). ACID Dam and RBDD presented partial barriers to salmonid migration until improvements were made in 2001 and 2012 (NMFS 2009, NMFS 2014a). The RBDD was decommissioned in 2013 providing unimpaired juvenile and adult fish passage.

Coarse sediment from the upper watershed is prevented from being transported downstream by Shasta and Keswick dams, resulting in an alluvial sediment deficit and reduction in fish habitat quality within the Upper Sacramento River reach (Wright and Schoellhamer 2004). In addition to the reduction of sediment supply, recruitment of large woody material to the river channel and floodplain has also declined due to a reduction in bank erosion and blockage of wood transport by Shasta Dam. The combination of degraded physical habitat characteristics, fish passage barriers, and changes in hydrology resulting from dams and diversions since the mid-1800s has been associated with salmonid declines within the Sacramento River watershed.

The Central Valley Regional Water Quality Control Board (CVRWQCB) has determined that the 25-mile segment of the Upper Sacramento River between Keswick Dam and the mouth of Cottonwood Creek is impaired by levels of dissolved cadmium, copper, and zinc that periodically exceed water quality standards developed to protect aquatic life (CVRWQCB 2013). The reach is also listed under Clean Water Act (CWA) 303(d) by the CVRWQCB for unknown sources of toxicity (CVRWQCB 2013). Water temperature in the Sacramento River is controlled by releases from Shasta, Whiskeytown, and Keswick reservoirs. NMFS issued an opinion on the long-term operation of the Central Valley Project (CVP) and State Water Project (SWP) (NMFS 2009, NMFS 2019b), which included Upper Sacramento River water temperature requirements to protect listed anadromous fish and their critical habitats. However, the ability to meet temperature requirements has proven extremely difficult during drought years.

Historically, both CV spring-run Chinook salmon and CV steelhead spawned in many of the headwaters and upstream portions of the Sacramento River and San Joaquin River basins. Similar to winter-run Chinook salmon, passage impediments have contributed to substantial reductions in the populations of these species by isolating them from much of their historical spawning habitat. The PBF of freshwater spawning sites for these species has been degraded within the action area due to high water temperatures, redd dewatering, and loss of spawning gravel recruitment in reaches below Keswick Dam (Wright and Schoellhamer 2004; Good et al. 2005; NMFS 2009; Jarrett 2014). These issues are actively addressed by adaptive flow management in both rivers as well as spawning gravel augmentation projects in both reaches (NMFS 2009; 2015d; 2016e).

Freshwater rearing and migration PBF’s have been degraded from their historical condition within the action area. In the Sacramento River, riverbank armoring has significantly reduced the quantity of floodplain rearing habitat for juvenile salmonids and has altered the natural geomorphology of the river (NMFS 2014b). Similar to winter-run Chinook salmon, CV spring-run and CV steelhead are only able to access large floodplain areas under certain hydrologic conditions which do not occur in drier years. Levee construction involves the removal of riparian vegetation, resulting in reduced habitat complexity and shading, making juveniles more susceptible to predation. Additionally, loss of riparian vegetation reduces aquatic macroinvertebrate recruitment resulting in decreased food availability for rearing juveniles (Anderson and Sedell 1979; Pusey and Arthington 2003).

Status of Sacramento River Winter-run Chinook Critical Habitat in the Action Area

The proposed action area contains a significant portion of the riverine critical habitat PBFs for winter-run Chinook. Wide-spread degradation to these PBFs has had a major contribution to the status of the winter-run ESU, which is at high risk of extinction (NMFS 2016c). PBFs include: (1) access to appropriate spawning areas in the upper Sacramento River, (2) the availability of clean gravel for spawning substrate, (3) adequate river flows for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles, (4) water temperatures between 42.5 and 57.5°F (5.8 and 14.1°C) for successful spawning, egg incubation, and fry development, (5) habitat and adequate prey that are not contaminated, (6) riparian habitat that provides for successful juvenile development and survival, and (7) access downstream so that juveniles can migrate from the spawning grounds.

The upper Sacramento River below Keswick Dam is critically important for the survival and recovery of this species as it contains the only known remaining spawning grounds. The majority of spawning occurs between Red Bluff (Red Bluff Diversion Dam) and Redding (below Keswick Dam) (Vogel and Marine 1991; NMFS 2014b). A fish passage improvement project at the ACID dam was completed in 2015, so that adult winter-run Chinook salmon could migrate through the structure at a broader range of flows. There is an ongoing effort to restore 42 miles of salmon habitat on Battle Creek as part of the Battle Creek Salmon and Steelhead Restoration Project (Bottom et al. 2005), leading to Pacific Gas and Electric's application to the Federal Energy Regulatory Commission to modify operations of hydropower projects on North Fork and South Fork Battle Creek (NMFS 2009). These improved flows and re-opening of spawning and rearing habitat is expected to benefit winter-run Chinook salmon when reintroduced to the stream, and to aid in the recovery of this species. The LSNFH also began operation in 1997 and functions to supplement the naturally occurring population of Sacramento River winter-run Chinook salmon in order to aid in its survival and recovery (California Hatchery Scientific Review Group [California HSRG] 2012). The facility is intended to be a temporary conservation measure and will cease operations once the population of winter-run Chinook salmon is considered to be viable and fully recovered.

There are uncertainties about Reclamation's ability to maintain an adequate cold water pool in Shasta Reservoir in order to maintain suitable temperatures for winter-run Chinook salmon egg incubation, fry emergence, and juvenile rearing in the Sacramento River in critically dry years and extended drought periods. Through NMFS' 2009 biological opinion on the long-term water operations of the CVP/SWP (NMFS 2009), Reclamation has created and implemented Shasta Reservoir storage plans and year-round Keswick Dam release schedules and procedures with the goal of providing cold water for spawning and rearing (NMFS 2016c).

Previously listed PBFs for this ESU have been degraded in a number of ways. Spatially, the total area of viable spawning habitat has been significantly diminished. Physical features that are essential to the functionality of existing spawning habitat have also been degraded, including loss of spawning gravel and elevated water temperatures during summer months when spawning events occur (NMFS 2014b). Degradation of these features is actively mitigated through real-time temperature and flow management at Shasta and Keswick dams (NMFS 2009) as well as gravel augmentation projects in the affected area, which have been occurring under a multi-year programmatic authority (NMFS 2016d).

Climate Change Impacts

Upper Klamath Basin

Average annual Northwest air temperatures have increased by approximately 1.8°F since 1900, or about 50 percent more than the global average warming over the same period (ISAB 2007). The latest climate models project a warming of 0.18°F to 1.08°F per decade over the next century. According to the Independent Scientific Advisory Board's (ISAB) recurring reports these effects will also likely instigate similar changes to seasonality and volume of hydrograph trends described earlier in the central valley with reduced snowpack and a shift to increased flows in winter rather than spring.

Water temperatures will reach extremes during the summer months with the combined effect of reduced flow and warmer air temperatures. Watersheds at high elevation may maintain temperatures below freezing for most of the winter and early spring and are expected to be less affected. Low-lying areas that have historically received scant precipitation contribute little to total streamflow and are likely to be more affected. These long-term effects may include, but are not limited to, depletion of cold water habitat, variation in quality and quantity of tributary rearing habitat, alterations to migration patterns, accelerated embryo development, premature emergence of fry, increased bio-energetic and disease stresses on fish, and increased competition among species. In addition, as climate change reduces the carrying capacity of habitat within the range of SONCC coho salmon, species viability may be more difficult to achieve (NMFS 2011a; NMFS 2014b). The reduced genetic diversity resulting from depressed population sizes may limit the ability of individual SONCC coho salmon to adapt to changing climatic conditions.

Climate change effects contributing to warming and reduced snowpack along with timber harvest and fire suppression have led to an increase in the number of large wildfires and the total area burned within the SONNC coho ESU and the Klamath-Trinity Mountains. Large wildfires produce mass-wasting events in high severity burn areas. Elevated levels of sediment introduction from surface erosion and mass-wasting are compounded by forest management actions including road networks, timber harvest activities, and historical fire suppression actions (Barr et al. 2010).

California Central Valley

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

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

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

Trinity Basin

According to models by the International Panel on Climate Change (IPCC 2007), the region near Lewiston, CA will experience an increase in air temperature of about 3°F from the historical period (1961-1990) to the modeled future period (2020-2050) assuming emissions peak around 2040 and then decline. Average annual mean precipitation is expected to increase approximately 2.3 inches from 35.9 inches to 38.2 inches from the historical period to modeled future period. There has already been a significant loss of snowpack in northern California, particularly at low elevations (Mote et al. 2018), and warming caused by climate change will continue to exacerbate future snowpack loss, regardless of any potential increases in precipitation (Zhu et al. 2005, Vicuna et al. 2007). A transition to a warmer climate state and sea surface warming may be accompanied by reductions in ocean productivity which affect fisheries (Ware and Thomson 2005; Behrenfeld et al. 2006). Due to the corresponding increase in water temperatures, decrease in summer and fall stream flows and potential declines in ocean productivity, the amount of habitat available to all life stages of SONCC coho salmon in the action area is expected to shrink and/or become less suitable. This is expected to reduce the number of successful offspring produced per adult spawner, and challenge the resiliency of SONCC coho salmon in the action area.

Importance of the Action Area for the Survival and Recovery of Listed Fish Species

The action area includes spawning habitat that is critical for the natural production of these species; rearing habitat that is essential for growth and survival during early life stages and enhances overall productivity and population health; and migratory corridors that facilitate anadromous life history strategies.

The NMFS Recovery Plan for the Sacramento River Winter-run Chinook salmon and Central Valley spring-run Chinook salmon ESUs and the California Central Valley steelhead DPS (NMFS 2014b) provides region-specific recovery actions that were identified by NMFS in order to facilitate recovery of these species. Implementation of some of these actions has already begun and more are in the planning phase. The Recovery Plan for SONCC coho provides similar information and guidance (NMFS 2014a).

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).

2.5.1 Presence and Exposure

The action area is used by various life stages of the ESA-listed salmonids considered in this biological opinion during proposed work, depending on the species' range. Adult and juvenile migration and rearing of listed salmon and steelhead are likely to be affected by the proposed action. The following listed salmonids and their life stages may be present at the proposed fish habitat and passage sites:

Table 3. Listed Species and Life Stages Present at Screen and Passage Facilities

Species	Life stages	Proposed activities in the following locations:
SONCC coho salmon	All	All Klamath and Trinity River basin sites
CV steelhead	All	Sacramento River basin: Cow Creek, Battle Creek, Salt Creek, Paynes Creek, Antelope Creek, Mill Creek, and Deer Creek
CV spring run Chinook salmon	All	Sacramento River basin: Battle Creek, Antelope Creek, Mill Creek, and Deer Creek
Winter run Chinook salmon	All	Sacramento River basin: Battle Creek

In this Biological Opinion NMFS focuses on effects of screen maintenance as well as fishing access and habitat improvements as proposed by FWS. We do not address the effects of agricultural water diversions from streams within the action area because they are not consequences of the proposed action. Work at most sites will commence in the spring with the onset of irrigation season and is expected to take no more than a few days at each site or as little as a few hours. Screens are typically removed in October or November for in-shop maintenance. Head gates are closed until March, which prevents access to the diversion and screen bay and thus reduces fish exposure to work activity. A minority of diversions that provide stock water will be open year round and require maintenance following high flow events. Emergency repairs will likely occur following storm events as receding flows allow. Juvenile salmonids are rarely observed by CDFW personnel in diversion structures as they tend to select more diverse habitat found in the mainstem. Migrating adults also generally avoid downstream high-velocity areas created by diversion inlets. On extremely rare occasions, adults have entered the screen bay area and were rescued by CDFW personnel. However, the vast majority of adults will be able to physically avoid the effects of maintenance work.

2.5.2 Negligible and Improbable Effects

This section focuses on only the project activities and their consequences that are expected to be negligible or improbable as explained further below.

2.5.2.1 Stream and Lake Habitat Improvements

Installation of woody material and cattle exclusionary fencing is not expected to produce adverse effects to listed species or their habitat. These work activities will be conducted manually and consequently have very low potential to introduce fine sediment to the channel. Existing trails and roads will be used for access with no new construction. Fencing may cross channels but will be suspended above the water and not interact with flow. Installation of new fencing and maintenance of existing exclusionary structures will prevent bovine access to streamside grazing and restore riparian function. Placement of Christmas trees, tree stumps, and brush structures will occur in reservoirs outside of habitat occupied by listed species. Juniper logs and willow cuttings will be installed manually in streams with little to no disturbance of any salmonids in the immediate area. Adverse effects from stream and lake habitat improvements are so unlikely to occur as to be considered improbable.

2.5.2.2 Fishing Access

Improvements to fishing access will take place outside the channel and be implemented by hand. Most work will consist of manually filling potholes on existing ramps and/or roadways and removal of encroaching tree limbs and invasive Himalayan blackberry along access trails. Some of this vegetation will be located in riparian areas but the scale of impact is small enough and the height and volume of impacted vegetation so inconsequential that the effects from the reduction of such vegetation will be minimal. The filling of potholes will take place during the dry season on a small scale with little chance of fill material being transported to the channel by storm water. Repairs to signage, turnstiles, and gates will be implemented far from occupied habitat and have no effect on listed species or habitat. NMFS does not expect that improvements to existing fishing access points will significantly change the total fishing effort or possible catch of listed species in the action area because existing conditions are unlikely to deter fishing opportunities at these sites. Possible effects from improvements to fishing access are therefore considered negligible.

2.5.2.3 Noise, Motion, and Vibration Disturbance from Heavy Equipment Operation

Routine and emergency maintenance activities of CDFW personnel may disturb fish, potentially affecting juvenile and adult salmonids through displacement and disruption of normal behaviors including spawning, migration, and rearing. Displacement may temporarily expose juvenile fish to a greater risk of predation and reduce foraging success. Current rearing conditions in the Klamath and Sacramento systems (*e.g.*, warm water, low-irregular flow, standing water, and water diversions) compared to its natural state decades ago in the pre-dam era, are more conducive to warm water species such as Sacramento pikeminnow and striped bass than to native salmonids. These fish prey on juvenile salmonids and are known to congregate below impoundments (Tucker et al. 1998). Some adult and juvenile listed fish may experience up to eight hours of migration delay at a given site due to maintenance activities during a normal work day. Repeated disturbance may potentially increase stress levels which could result in lower reproductive success in holding adult salmonids. However, adult fish are expected to be delayed only temporarily and actively avoid maintenance areas, therefore temporary disturbance is not considered a significant stressor for adults. Rearing habitat for juvenile fish is generally well-distributed throughout the action area with relatively low densities of competing fish, allowing for juvenile movement to other areas that are only slightly less suitable, as well as cover from predators. Disturbance to adult and juvenile listed fishes resulting from maintenance activity is expected to be short-term, lasting no more than 8 hours per day for a maximum of two days. Even at sites needing consecutive days of work, fish will have 16 hours of undisturbed activity per 24 hour period.

Salmon and steelhead could be subjected to noise levels sufficient to induce behavioral changes and at least temporarily interrupt spawning activity as well as migration of juveniles and adults. Noise, motion, and vibration produced by heavy equipment operation is expected at some diversion and passage sites. Heavy equipment will remain on the bank and reach into the channel at some sites to remove heavy debris, generating no more than 112 dB of noise (Nipko and Shields 2003). Temporary changes in fish behavior in response to noise include startling, altered behavioral displays, avoidance, displacement, and reduced feeding success. Multiple studies have shown responses in the form of behavioral changes in fish due to human produced noise (Wardle et al. 2001, Slotte et al. 2004, Popper and Hastings 2009). However, the number of fish exhibiting any one of these responses as a result of sound generated from construction activities will be minimal for the following reasons; only a small number of individuals have the potential to be present in the action area at a given time, equipment will remain on shore and produce noise below the threshold for a startle response in salmonids (130 dB), and noise will be discontinuous throughout the day and cease at night when most fish are migrating (Moyle 2002). Because of the proposed BMPs, limited heavy equipment use in the wetted channel, and low levels of acoustic impacts caused by proposed activities, the noise, motion, and vibration and disturbance are expected to cause only minor effects to listed species and critical habitat.

2.5.2.4 Disturbance to Riparian Vegetation

In the rare event that streamside riparian vegetation must be removed to provide access for maintenance, NMFS expects the loss of riparian vegetation to be small, and limited to mostly shrubs and an occasional tree. As much understory brush and as many trees as feasible will be retained, emphasizing shade producing and bank-stabilizing vegetation. The riparian vegetation types most likely to be affected are willows and other shrubs, which generally reestablish quickly (usually within one season). Therefore, NMFS anticipates the incidental, temporary loss of riparian vegetation to cause no more than minimal effects to individuals or critical habitat.

2.5.2.5 Crowding at relocation sites

In some instances, relocated fish may endure short-term stress from crowding at relocation sites. Relocated fish may also have to compete with other salmonids for available resources such as food and habitat. However, most relocated fish will likely choose not to remain in the relocation sites and will move either upstream or downstream as soon as possible to areas that have either more habitat or lower fish densities. The effects of competition are expected to quickly diminish as fish disperse. Therefore, the effect of increased competition after fish relocation is expected to be insignificant.

2.5.2.6 Water Quality

The proposed action will affect water quality during activities that disturb substrate and mobilize fine sediment. Debris removal from screen bays and fish passage structures using manual, mechanical, and flushing flow methods are expected to mobilize sediment and increase water turbidity beyond natural levels. Although most turbid water generated by maintenance will be discharged into the diversion canal, small amounts of fine sediment are expected to be released into the channel near diversions and passage structures. The greatest mobilization of sediment will likely occur at sites where heavy machinery reaches into the water to clear accumulated debris and when head gates are opened to allow flow to flush debris from screen bays. Suspended sediment concentrations increase rapidly with the onset of instream work and recede markedly with the cessation of work (Reid and Anderson 1998). The effects of turbidity on fish have been well documented in research literature and range from beneficial to lethal. Moderate turbidity levels (35 to 150 Nephelometric Turbidity Units (NTUs)) can provide cover and accelerate foraging rates in juvenile salmonids (Gregory and Northcote 1993). Higher turbidity concentrations can cause physiological stress and inhibit growth and survival. Direct mortality can occur at very high concentrations and/or extended durations of suspended solids (Newcombe and Jensen 1996).

Fish will be exposed to increased turbidity by the fish habitat and passage program activities, but several factors will reduce the potential impact of suspended sediment. Project maintenance during low flow in the late summer and fall will greatly reduce transport potential of fine sediments, allowing most particles to rapidly fall out of suspension and limit fish exposure. Gradual reintroduction of flow at sites maintained during the winter and spring will avoid a sudden flushing of fines and allow turbidity levels to dilute and remain close to background levels during these periods of typically high sediment transport. Exposure to mobilized sediment is expected to be brief and minor since any debris or sediment removal associated with maintaining fish screens will result in suspended sediment in the diversion canal and not back instream (CDFW 2019) and debris removal associated with maintaining ladders and baffles is primarily by hand, hand tools, or small equipment. Since CDFW inspects and maintains the ladders and baffles weekly during the adult migration period and monthly the rest of the year and these passage structures have flows through them, we do not expect large accumulation of sediment in front of these structures to require heavy equipment to remove them. The unlikelihood of large sediment accumulation would contribute to minimal sediment mobilization during and after debris or other activities associated with fish ladder and baffle maintenance.

The Scott River, Cottonwood Creek, Parks Creek, Little Shasta River, Shackleford Creek, and Kidder Creek all have four screens or more. Normally all sites on a specific creek are maintained in a day, with a travel distance of half to one hour between sites for the CDFW crew. It is possible for migrating juvenile coho salmon to be repeatedly exposed to the effects of screen maintenance in these streams although potential exposure would be a matter of hours at most for each site.

Concentrations of suspended sediments high enough to adversely affect listed species are expected to be localized near work activity with a maximum duration of a few hours episodically over one or two days. Concentrations somewhat higher than background will occur farther downstream. Fish within 300 feet of the work area will have unrestrained opportunity to physically avoid the worst effects of the sediment plume. NMFS does not expect the small amount of sediment mobilized by maintenance work to redistribute in a manner that alters the value of local habitats for rearing, spawning, or migration.

Fifty NTUs is above the range at which salmonids experience reduced growth rates (Sigler et al. 1984) but below the range salmonids would be expected to actively avoid the area (Bisson and Bilby 1982). NMFS expects turbidity will not increase more than 50 NTUs over background levels because turbidity generated by maintenance activity will be short-lived lasting for a matter of hours, and mostly contained with the diversion ditch at a majority of sites or within isolated areas.

Additional impairment of water quality may result from accidental releases of fuel, oil, and other contaminants that can injure or kill aquatic organisms. Such releases, while rare, are reasonably likely to occur from the use of heavy equipment. Petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, contain polycyclic aromatic hydrocarbons (PAHs), which can kill salmonids at high levels of exposure, and can cause sub-lethal, adverse effects at lower concentrations (Meador et al.). Due to BMPs, including having heavy equipment only operating from the road, it is unlikely that there would be spills into salmonid waterways or releases larger than a few ounces from project activities. For these reasons, effects to individuals and critical habitat from PAHs and turbidity are expected to be minor.

2.5.2.7 Woody Material Removal

Woody material provides several vital roles in the stream ecosystem including; increasing channel complexity and pool frequency and size, stabilizing areas of scour and deposition, trapping and allowing organic material to cycle in place, providing cover and velocity breaks for fish, increasing floodplain roughness, and creating attachment points for invertebrates (Naiman et al. 2002). Debris collected by diversions and passage structures often includes woody material. Most of this material consists of broken, loose, floating debris that will be removed from the channel. The relocation of larger woody materials from screens, ladders or baffles (≥10 cm or more in diameter and ≥ one meter in length) to downstream channel will maintain or even improve the functionality of larger woody material to the stream ecosystem. No loss in ecosystem function is expected from the removal of a relatively small portion of the overall fine particulate organic material load at maintenance sites and effects from this activity are therefore likely to be undetectable to listed fish and their critical habitat.

2.5.2.8 Forage

Maintenance activity is likely to directly kill some benthic invertebrates and redistribute sediment downstream of work activity, potentially reducing foraging opportunities to a slight degree for juvenile salmonids. Potential direct injury by crushing will take place over a very small scale spatially and temporally. NMFS expects the disturbed area will be quickly recolonized by invertebrates from surrounding, unaffected habitat. At most, only a fine layer of sediment has the potential to be deposited over downstream substrate. Spawning activity will be sufficient to clear this layer or it will be flushed by high flow events. Suspension and deposition of instream sediments is therefore expected to be localized and temporary and will not reach a level that will acutely affect aquatic invertebrates or interfere with salmonid embryonic development within redds. Any reductions in forage opportunity is therefore expected to be negligible for listed species and their critical habitat.

2.5.3 Adverse Effects to Species and Critical Habitat

2.5.3.1 Fish Relocation and Electrofishing

Fish exclusion prior to dewatering and debris removal using heavy equipment are likely to directly affect juveniles present in the work area. Adults are physically able to avoid work activity and are not expected to be present during fish removal activities, but in the unlikely event that adults are found in the work area, they will be safely removed via herding. Fish exclusion activities will commence with deployment of a seine net to herd fish out of the work area and the anchoring of the net in place to prevent reentry. Based on experience conducting similar operations involving isolation and relocation of fish in natural channel conditions, NMFS has estimated that fish seining was likely to herd approximately 75% of juvenile salmonids from the work area (NMFS 2018). Herding fish from each site by seining should be more effective given the physically homogenous and confined nature of diversion canals and passage structures. NMFS therefore estimates that the fish seining operation will achieve a higher degree of efficiency and is likely to herd at least 90% of juvenile fish out of the work area. A qualified biologist will follow appropriate BMPs, as described in the BA, to capture and relocate fish.

Fish relocation may include employment of electrofishing according to NMFS protocols. Most captured fish are expected to be released unharmed. However, it is possible that relocation efforts, including electrofishing, could induce physiological stress or mortality even when performed by a skilled fish biologist. Any fish collecting gear, whether passive or active (Hayes 1983), has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of 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. Electrofishing can kill juvenile salmonids, and researchers have found serious sub lethal effects including spinal injuries (Reynolds 1983, Habera et al. 1996, Habera et al. 1999, Nielsen 1998, Nordwall 1999). The long-term effects of electrofishing on salmonids are not well understood. Although chronic effects may occur, most effects from electrofishing occur at the time of capture and handling.

Juvenile densities are expected to be low given the lack of desirable habitat in diversion canals and screen bays. Any juveniles displaced from the work area should have little competition for use of surrounding habitat and are therefore not expected to suffer adverse effects. Juveniles that are not successfully removed from the isolation area during the initial seining will be subject to capture during the remaining phases of fish exclusion.

Routine and emergency maintenance is expected to adversely affect a small number of salmonids in the action area. Because of the variability and uncertainty associated with the population sizes of the species, annual variation in the timing of migration, and variability regarding individual habitat use of the action area, the actual number of individuals present in the action area during the work window is not known, though expected to be low at diversion and passage structures.

Given the precedent of other programmatic NMFS opinions and the similarity of fish capture and relocation methods to be employed in the action area, we assume that on average, fish will be injured or killed on a similar basis to that experienced in Northern California (NMFS 2012; 2016d). Data recorded for projects from 2009 – 2017 (NMFS 2017), revealed a 3 percent mortality rate. Therefore, the electrofishing/capture/handling/relocation process, is expected to produce a total immediate mortality rate of no more than 3% of relocated fishes.

2.5.3.2 Dewatering, and Mechanical Injury

Any further juveniles remaining in the work area by eluding fish relocation efforts would be at high risk of mechanical injury and death from crushing during debris removal and maintenance work. Remaining juveniles evading capture and relocation would also be exposed to desiccation induced mortality if the area is dewatered but this number is expected to be low given the exclusion measures employed and limited number of fish that may occupy sub-optimal habitat in the diversion area as described previously. An estimated five juvenile coho salmon were expected to be killed each year as a result of dewatering and mechanical injury from fish screen and associated maintenance activity from 55 fish screen facilities in Siskiyou County (Lis 2015 *in* NMFS 2015). Since the number of fish screens maintained under the proposed action (i.e, 58) is similar to the 55 screens referenced above, we assume that no more than 6 listed juvenile salmonid may be killed each year from the proposed dewatering and mechanical injury associated with program maintenance. Dewatering will also result in adverse effects to critical habitat because water will be removed from a portion of the sites. These adverse effects will be temporary, as water will be returned to the sites when work is completed.

2.5.3.3 Screen Impingement at Existing Facilities

Several intake screens and fish passage structures are currently not in compliance with NMFS criteria, such as ladders that fail to meet fish passage criteria at targeted flows, excessive or non-adjustable jump heights and velocities at ladders, bypass ditches that are nonexistent or too steep, no porosity controls at screens to evenly distribute velocity, and lack of louvers, which together can create impingement hazards on portions of the screen to diseased or otherwise weakened fish.

NMFS screen criteria are designed to protect the weakest swimming species present at their most vulnerable life stage (NMFS 1997). Field and laboratory studies (Rose et al. 2008, Zydlewski et al. 2000) reported survival rates from 98 to 100% for juvenile salmonids exposed to fish screens meeting NMFS criteria. Hydraulic conditions noncompliant with NMFS criteria have been shown to produce injury at simulated screens. For instance, Swanson et al. (2004) found that in the absence of NMFS mandated sweeping flows, juvenile Chinook salmon contacted a simulated screen at greater frequency than with sweeping flows in place, as well as with increased approach velocities, and that less than 0.3% of juvenile Chinook salmon exposed to fish screens were impinged. Fish in this study exhibited injury although survival remained extremely high at greater than 99.8%. Because fish exposure to screens was only two hours and survival was assessed over only 48 hours post-experiment from a predator-free environment, NMFS expects the mortality rate would increase slightly with continued exposure to screen contact or impingement produced by inadequate sweeping velocities or other NMFS noncompliant criteria over an extended time. Additionally, CDFW will backwater screens to meet approach and sweeping velocity criteria (Roberts 2020), and impingement hazards will likely only occur over a small subset of intake flows and affect only juveniles in a weakened state. Nevertheless, mortality from mostly compliant fish screens is likely to be no more than 1 percent of fish exposed to those fish screens and no more than 1 listed juvenile salmonid annually from each fish screen since mortality observed in Swanson et al. (2004) did not appear to be related to observed impingements. This mortality estimate includes injuries from impingement since we assume injured fish will likely be killed. While there may be a small percentage of juvenile salmonids that may be injured or killed under a worst case scenario, NMFS notes that the proposed action is significantly better than having unmaintained or no screens.

Until screen facilities are upgraded, adverse effects in the form of impingement are expected to continue. However, even though some facilities do not fully meet current standards, they still provide a high level of function in preventing entrainment mortality into diversion ditches and fourteen screens will be upgraded within the next two years (CDFW 2019) and as maintenance/repair occurs. CDFW also routinely checks diversions to ensure functionality, thus limiting exposure to adverse effects. Adults are able to physically avoid contact with screens and are not expected to suffer negative effects.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline *vs.* cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are described in the environmental baseline (Section 2.4).

Hatchery Influence

While there are several hatcheries in the Klamath Basin and Sacramento Valley, only the Iron Gate Hatchery's Chinook salmon program is a future non-Federal action. Chinook salmon from the Iron Gate Hatchery migrate and rear in the Klamath River with coho salmon in the action area. Until approximately eight years after the Klamath Dams are removed, IGH Chinook salmon are expected to adversely affect naturally produced coho salmon in the action area through competition in the Klamath River. Suitable freshwater habitat availability for juvenile coho salmon rearing and migration is expected to decrease in the future due to climate warming (Mote et al. 2003, Battin et al. 2007). Thus, competition for limited thermal refuge areas among salmonids will increase. However, hatchery releases are expected to remain constant during this period of shrinking freshwater habitat availability. This may increase the detrimental impacts to naturally produced coho salmon from density-dependent mechanisms in the freshwater environment.

Agriculture

Agriculture activities are expected to continue to degrade water quality through reductions in flow, excessive nutrient introduction, herbicide and pesticide use, and increased water temperatures throughout the action area as discussed in the Environmental Baseline section. Continuing cattle grazing and dairy farming can also degrade or reduce suitable habitat for listed salmonids by increasing erosion and sedimentation, as well as introducing nitrogen, ammonia, and other nutrients into streams throughout the action area.

Timber Harvest

Resource-based industries are likely to continue to have an influence on environmental conditions within the action area for the indefinite future. The lack, or inadequacy, of protective measures in existing regulatory mechanisms, including land management plans (e.g., State Forest Practice Rules), contribute varying degrees to the decline of listed salmonids. Sedimentation and loss of spawning gravels associated with poor forestry practices and roadbuilding are particularly chronic problems that can reduce the productivity of salmonid populations. However, resource extraction industries have adopted management practices that reduce many of their most harmful impacts, which were unknown or in uncommon use until recently.

Residential Development

Human population growth in the action area is expected to remain relatively stable over the next 10 years. Development will continue to occur which, on a small-scale, can impact listed salmonid habitat. Increases in urbanization and housing developments will likely impact habitat by altering watershed characteristics and changing both water use and stormwater runoff patterns. Once development and associated infrastructure (e.g., roads, drainage, and water development) are established, the impacts to aquatic species are expected to be permanent.

Unscreened Water Diversions

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the action area. Thousands of water diversions exist along the Klamath River and Sacramento River basins and many of them remain unscreened. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile listed anadromous species (Mussen et al. 2013; Mussen et al. 2014). For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment. Most of the 370 water diversions operating in Suisun Marsh are unscreened (Herren and Kawasaki 2001).

Cannabis Regulation

In 2018, the State of California legalized the recreational use of cannabis, as well as the cultivation and manufacture of cannabis plants and products. The state's regulatory framework is in place or under development and is likely to reduce the number of illegal cannabis farms, and cannabis farms that cause detrimental impacts to salmonid habitat. There are many cannabis farms which cumulatively reduce flow volume and increase discharge of waste and pollutants in streams which affects water quantity and water quality in the action area.

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 (Section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) Reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) appreciably diminishes the value of designated or proposed critical habitat for the conservation of the species.

Cumulative effects will continue to shrink the amount of habitat available to listed species in the action area and throughout their respective range. This will likely reduce the number of successful offspring produced per adult spawner, and challenge the resiliency of listed species in various ways including the exacerbation of competition with hatchery produced fish. Pending removal of impoundments on the Klamath River will restore access to upstream habitat and likely improve water quality but water withdrawal and other agricultural activities will continue to degrade habitat. Timber harvest and residential development will further impact watershed function within each ESU on a larger scale but effects at individual sites of the action area may be difficult to discern. The legalization of cannabis in California is likely to have a beneficial effect to the species, as production of cannabis shifts from areas within the SONCC ESU, to parts of the state more suitable to agriculture or indoor growing. Nonetheless, illegal marijuana cultivation and associated ill effects of water withdrawal and increased sedimentation is expected to linger for some time. Improvement of fishing access is not anticipated to increase bycatch of listed species to a significant degree.

The SONCC coho salmon ESU is currently considered likely to become endangered within the foreseeable future in all or a significant portion of its range (Williams et al. 2016). Williams et al. (2016) found that there has been no trend toward recovery of SONCC coho salmon since their listing in 1997. The lack of increasing abundance trends across the ESU for the populations with adequate data are of concern (e.g., Shasta River). Moreover, the loss of population spatial scale estimates from coastal Oregon populations is of great concern. The new information since Williams et al. (2011) while cause for concern, does not appear to suggest a change in extinction risk at this time. While some improvements in factors affecting population units in the action area have improved habitat in some areas (e.g., Trinity River restoration, improvements in hatchery practices), populations in the action area overall have not trended toward recovery.

Populations of winter-run and spring-run Chinook salmon and CV steelhead in California have declined drastically over the last century, and some subpopulations have been extirpated. The current status of listed salmonids within the action area, based upon their risk of extinction, has not significantly improved since the species were listed (NMFS 2014b). This severe decline in populations over many years considered in the context of the degraded environmental baseline, demonstrates the need for actions which will assist in the recovery of all of the ESA-listed species in the action area. If measures are not taken to reverse these trends, the continued existence of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, and CV steelhead could be at risk.

Currently accessible salmonid habitat throughout the action area has been severely degraded. Intensive land and stream manipulation during the past century (e.g., logging, agricultural/livestock development, mining, urbanization, unscreened diversions, and impoundments) has modified and eliminated much of the historic anadromous fish habitat in the Klamath Basin and Sacramento Valley. In addition, current water operations can limit the spatial extent of cooler-water habitat downstream of dams, which reduces the available habitat for spawning and egg incubation (based on water temperature suitability). Although the current conditions of salmonid habitat are significantly degraded, the remaining habitat for spawning and egg incubation, migratory corridors, and rearing is considered to have high intrinsic value for the conservation of the species.

The impact of the proposed action on critical habitat is described in Section 2.5. The proposed action will have temporary or minimal effects on habitat space, water quality, riparian vegetation, removal of fine organic material, forage availability, and disturbance. The remaining effects as explained previously, are expected to occur on limited spatial and temporal scales and some are beneficial to habitat. With the exception of some passage structures, the scale and degree of effects are expected to be minimal or temporary with respect to the overall function of PBFs in both the action areas and at the larger watershed scale. The effects from the environmental baseline in the larger project area already suppress juvenile to adult survival because of extensive degradation to water quantity, quality, and temperature. The cumulative effects of state and private actions within the action area are anticipated to continue at approximately the same level that they are now occurring. Adding the effects of the action and cumulative effects within the action area to baseline conditions are not anticipated to result in significant changes in the overall condition of listed species or critical habitat, as summarized below.

As described in the preceding effects section, individual fish are likely to experience adverse effects during maintenance activity from relocation, crushing, turbidity exposure, and disturbance. However, the number of individual listed salmonids present to experience adverse effects will be limited by several factors. Maintenance activities will be episodic, occurring a few times each year and typically when fish are migrating with limited exposure to work activity at any given site. Herding, temporary blocking the disturbance area, and any necessary fish relocation will reduce the number of fish that may be crushed, exposed to elevated suspended sediment, and disturbance. After herding and blocking access, the likely low number of fish present at maintenance sites would be relocated, of which up to 3% may experience injury or mortality. Head gates will remain closed at most sites through the winter, precluding the presence of salmonids in those screen bays prior to cleaning in spring. BMPs, including herding fish from the area with seines, will significantly reduce the numbers of any fish that may occupy bays in screened diversions that are active year-round. NMFS expects no more than six juveniles will be killed annually from all dewatering and mechanical cleaning within diversions associated with maintenance work over the ten year life of the project. Up to one juvenile per year may suffer mortality from impingement at each noncompliant screen. Adults are expected to physically avoid sites during maintenance. Juveniles and adults will be able to avoid the worst effects of increased turbidity.

Because injury or mortalities are limited, and for all but winter-run Chinook salmon diluted across multiple populations, the effects of the proposed action are unlikely to appreciably reduce the survival and recovery of SONCC coho, CV steelhead, and CV spring-run Chinook at the diversity stratum or ESU/DPS scale. For winter-run Chinook salmon, the small losses in numbers are expected to be offset by ongoing restoration efforts and thus similarly these losses are unlikely to appreciably reduce the survival and recovery of winter-run at the ESU/DPS scale. Implementation of the proposed action will continue the protection of listed species by maintaining structures that largely prevent entrainment of individuals and provide access to upstream habitat beyond barriers. Some juvenile mortality is expected, but this impact will not appreciably alter the abundance of listed species populations in future years or appreciably affect long term population trends. Effects to the critical habitats of these species are mostly relatively minor or temporary. For example, small stream reaches containing screened diversions will be dewatered and then rewatered during one construction season. After rewatering, habitat space will return to its previous function. Passage structures that do not meet NMFS' criteria will continue to reduce migration habitat to some degree until structures are upgraded. As indicated in the analysis above, this reduction in migration habitat is limited in space and time, and is unlikely to reach worst case scenarios for juveniles or appreciably reduce the value of critical habitat as a whole.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species, 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 of SONCC coho, CV steelhead, Sacramento River winter-run Chinook, or CV spring-run Chinook, or destroy or adversely modify the critical habitats of these species.

2.9 Incidental Take Statement

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

2.9.1 Amount or Extent of Take

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

NMFS expects that up to 3% of the captured may be injured or killed at each relocation site annually. NMFS also expects that up to 1 SONCC coho salmon, winter run Chinook salmon, CV spring run Chinook salmon, and CV steelhead juvenile will be killed by dewatering for each dewatering occurrence. NMFS expects that up to 1 SONCC coho salmon, winter run Chinook salmon, CV spring run Chinook salmon, or CV steelhead juvenile exposed to fish screens will be injured or killed each year through impingement with each program fish screen over the ten year lifespan 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.

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 SONCC coho salmon, spring-run Chinook salmon, winter-run Chinook salmon, and CV steelhead:

1. Minimize the amount or extent of incidental take of listed salmonids resulting from maintenance activity and associated capture and relocation of fish.
2. Minimize the amount or extent of incidental take of listed salmonids resulting from fish screens.
3. Monitoring the project to ensure that the conservation measures are meeting the objective of minimizing take and that the amount or extent of take is not exceeded.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the CDFW or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). The CDFW or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:

A. Salmonids shall be handled with extreme care and kept in water to the maximum extent possible during rescue activities. All captured fish must be kept in cool, shaded, and aerated water protected from excessive noise, jostling, or overcrowding or potential predators any time they are not in the stream, and fish will not be removed from this water except when released. Captured salmonids will be relocated as soon as possible to an instream location in which suitable habitat conditions are present to allow for adequate survival for transported fish and fish already present. Fish will be distributed between multiple pools if biologists judge that overcrowding may occur in a single pool.

B. With at least 24 hours advance notice, FWS and CDFW shall 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.

C. CDFW shall contact NMFS within 24 hours of meeting or exceeding take of listed species prior to project completion. Notify Roman Pittman by phone at 707-825-5167 or email at Roman.Pittman@noaa.gov. This contact acts to review the activities resulting in take and to determine if additional protective measures are required.

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

   CDFW shall coordinate annually with NMFS' Environmental Services Branch to assess fish screens, identify measures to increase effectiveness of screens, and prioritize upgrading structures to meet the latest NMFS fish screen criteria or guidelines. CDFW will rebuild at least one fish screen each year to meet the latest NMFS screening criteria/guidance. Within ten years, all of the fish screens covered in this Opinion will be updated to the latest NMFS fish screen criteria/guidelines or receive NMFS approval for a variance.

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

   CDFW shall submit an annual project report to NMFS by March 1 of each year. All reports will be sent to the National Marine Fisheries Service, North Coast Branch, 1655 Heindon Road, Arcata, California 95521, or delivered via electronic mail to: roman.pittman@noaa.gov. Correspondence should reference NMFS Consultation Number: WCR-2019-03810. The report shall include, at a minimum, the following:

   (a) Dates and location description of work activity including photographs.
   (b) Electrofishing settings (see Appendix A).
   (c) Number and species of fish captured, observed injured, or killed at each site.
   (d) A brief narrative of the circumstances surrounding salmonid injuries or mortalities.
   (e) Number and species of fish captured and successfully relocated at each site.
   (f) A description of the equipment and methods used to collect, hold, and transport salmonids.
   (g) Number, date, and location of facility upgrades.
   (h) Approach and sweeping velocities for each screen.

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 recommends FWS and CDFW upgrade all CDFW's fish passage structures pursuant to the latest NMFS fish passage criteria or work with NMFS' Environmental Services Branch to receive variance approval as soon as practical.

2.11 Reinitiation of Consultation

This concludes formal consultation for CDFW's Wildlife Northern Region Fish Habitat and Passage Program.

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

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

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

This analysis is based, in part, on the EFH assessment provided by the CDFW and the U.S. Fish and Wildlife Service 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

Suitable salmon habitat is contained within the Trinity, Upper Klamath, and Sacramento rivers as described in the action area. Specific habitats identified in PFMC (2014) for Pacific coast salmon include Habitat Areas of Particular Concern (HAPCs), identified as: 1) complex channels and floodplain habitats; 2) thermal refugia; and 3) spawning habitat. HAPCs for salmon also include all waters and substrates and associated biological communities falling within the habitat areas defined above. Habitat located within the proposed action area are considered HAPC as defined in PFMC (2014). HAPCs are considered high priority areas for conservation, management, or research because they are rare, sensitive, stressed by development, or important to ecosystem function.

3.2 Adverse Effects on Essential Fish Habitat

The adverse effects to Pacific Coast salmon are similar to the effects to SONCC coho salmon, CV steelhead, and Sacramento winter-run and CV spring-run Chinook critical habitat described previously. The adverse effects to EFH and HAPCs in the action area include:

1. Maintenance work at screens and passage structures will temporarily mobilize sediment and locally increase turbidity levels.
2. Some organic debris will be removed from the channel during cleaning activities.
3. Stream invertebrates will be displaced or killed by debris removal from screen and passage structures.

3.3 Essential Fish Habitat Conservation Recommendations

Section 305(b)(4)(A) of the Magnusson-Stevens Fishery Conservation and Management Act authorizes NMFS to provide EFH Conservation Recommendations that will minimize adverse effects of an activity on EFH. Although adverse effects are anticipated as a result of project activities, the proposed minimization and avoidance measures, and terms and conditions in the accompanying opinion are sufficient to avoid, minimize and/or mitigate for the anticipated effects. Therefore, no EFH Conservation Recommendations are necessary at this time to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH.

3.4 Supplemental Consultation

The U.S. Fish and Wildlife Service and CDFW 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 effects the basis for NMFS' EFH Conservation Recommendations (50 CFR600.920(1)).

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 are CDFW and the U.S. Fish and Wildlife Service. Other interested users could include owners of irrigated lands and holders of agricultural water rights. Individual copies of this opinion were provided to the CDFW. The format and naming adheres to conventional standards for style.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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6 APPENDIX A
Electrofishing Log Field Form

**(1 form for each day to be submitted w/species relocation report.
Report requirements on reverse.)**

Date: **Start Time:** **End Time:**

Project Name:

Stream and Watershed Names:

Crew Leader: **Phone Number:**

Starting Air Temperature: **Ending Air Temp:**
Starting Water Temperature: **Ending Water Temp:**
Conductivity (µS/cm): **Est Flow (CFS):**
Water Clarity (Circle): Poor / Fair / Good / Excellent

Electrofisher Manufacturer: **Model:**

Electrofisher Settings (For each pass*):

First pass:
Current (Circle): DC / PDC **Voltage:** **Frequency:** **Pulse width:**

Second pass:
Current (Circle): DC / PDC **Voltage:** **Frequency:** **Pulse width:**

Third pass:
Current (Circle): DC / PDC **Voltage:** **Frequency:** **Pulse width:**

Total Effort (seconds):

(*If effort is complicated due to segmenting stream, please indicate any different settings per pass per segment in comments below. If same settings are used in all segments, there's no need to give settings for different segments.)

Comments: