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

August 21, 2020 **Refer to NMFS No:** WCRO-2019-03827

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Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Trinity River Restoration Program's Mechanical Channel Rehabilitation, Sediment Management, Watershed Restoration, and Monitoring Actions in Trinity County, California

Dear Mr. Dixon, Mr. Everson, Ms. Mata, Ms. Cohen, and Mr. Russell:

Thank you for the Trinity River Restoration Program's letter of December 30, 2019, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Trinity River Restoration Program's Mechanical Channel Rehabilitation, Sediment Management, Watershed Restoration, and Monitoring Actions. Subsequently, the Fish and Wildlife Service, Bureau of Land Management, Shasta-Trinity National Forest, and the U.S. Army Corps of Engineer requested to be participating Federal agencies for this consultation. This consultation was conducted in accordance with the 2019 revised regulations that implement section 7 of the ESA (50 CFR 402, 84 FR 45016).

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

Based on the best scientific and commercial information available, NMFS concluded in the biological opinion that the proposed action is not likely to jeopardize the continued existence of the Southern Oregon/Northern California coast (SONCC) coho salmon evolutionarily significant unit, or destroy or adversely modify designated critical habitat for this species. Additionally, NMFS concurred that the Proposed Action is not likely to adversely affect the Distinct Population Segment (DPS) of southern resident killer whale, southern DPS of North American Green sturgeon, southern DPS of eulachon, or the southern DPS of eulachon designated critical habitat.

Please contact Roman Pittman in NMFS' Northern California Office in Arcata, California, Office at 707-825-5167 or by email at 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: ARN 151422WCR2019AR00268

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

Trinity River Restoration Program's Mechanical Channel Rehabilitation, Sediment Management, Watershed Restoration, and Monitoring Actions

NMFS Consultation Number: WCRO-2019-03827

Action Agencies: Bureau of Reclamation, U.S. Fish and Wildlife Service, U.S. Forest Service, Bureau of Land Management, and U.S. Army Corps of Engineers

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
Southern Resident Killer Whale *(Orcinus orca)*	Endangered	No	No	N/A	N/A
Southern Eulachon (*Thaleichthys pacificus*)	Endangered	No	No	No	No
Southern Green Sturgeon (*Acipenser medirostris*)	Threatened	No	No	N/A	N/A

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: August 21, 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, as amended.

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

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the NOAA Library Institutional Repository (https://repository.library.noaa.gov/welcome). A complete record of this consultation is on file at Arcata, California NMFS office.

1.2 Consultation History

On December 30, 2019 NMFS received a request from the Bureau of Reclamation's Trinity River Restoration Program (TRRP) to initiate formal consultation on Trinity River mainstem channel rehabilitation, fine and coarse sediment management, watershed restoration, and monitoring actions. On January 29, 2020, NMFS requested additional information from the TRRP. On February 4th, 2020 the TRRP responded and NMFS determined that sufficient information had been submitted to begin consultation.

On January 21, 2020, NMFS received the Bureau of Land Management's (BLM) request to initiate formal consultation as a participating agency under the TRRP. On January 30, 2020, the U.S. Fish and Wildlife Service (FWS) requested formal consultation as a participating agency under the TRRP. On March 2, 2020, NMFS received the Shasta-Trinity National Forest's (STNF) request for formal consultation as a participating agency under the TRRP.

On June 2, 2020, the TRRP agreed to extend the consultation to August 30, 2020, to develop an interagency coordinated process for including restoration, monitoring and research projects by the TRRP and participating federal agencies and to continue to reach out to the Corps to be a participating federal agency. On June 23, 2020, the Corps responded to NMFS inquiry and stated they would like to be a participating agency for this consultation.

On August 3, 2020 the TRRP indicated that turbidity at shallow water injection sites would be controlled by gradually introducing clean gravels. On August 4, 2020, the TRRP agreed to

remove blasting and the brown trout study from the Proposed Action. On August 5, 2020 the TRRP requested that electrofishing be included for research and monitoring purposes and proposed to herd fish with seines from shallow water gravel augmentation sites prior to gravel placement. On August 17, 2020, NMFS and TRRP representatives corresponded via email about bank stabilization, and the TRRP agreed to add more conservation measures for streambank stabilization activities.

1.3 Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). 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).

The Bureau of Reclamation (Reclamation) proposes to fund, implement, or facilitate restoration activities in the Trinity River watershed and monitoring and research activities in the Trinity and lower Klamath basins under the Trinity River Restoration Program (TRRP). The purpose of the TRRP is to mitigate impacts of the Trinity River Division of the Central Valley Project (CVP) on anadromous fish populations in the Trinity River by successfully implementing the 2000 Trinity ROD and achieving Congressionally-mandated restoration goals. TRRP's ongoing restoration activities are designed to increase in-river salmon and steelhead production by reestablishing habitat forming processes and complex instream habitat for salmonids within the action area.

As participating federal agencies, the FWS, BLM, STNF, and Corps may also implement, fund, and/or permit restoration, monitoring, and/or research activities in the Trinity and lower Klamath basins. Restoration, monitoring, and research activities that may result from the TRRP and/or participating federal agencies include:

1) Channel rehabilitation including: Reconnecting the floodplain to the river channel, incorporating engineered log jams, side channels, alcoves, and hard points and boulders to direct scour.

2) Fine and coarse sediment management including: Dredging of sediment retention ponds and adding coarse sediment to the river channel.

3) Infrastructure modifications and improvements including: Limited bridge replacement, the Well Grant Program to mitigate for adverse effects of restoration flows on water supplies of private riverside landowners, and bioengineered bank stabilization.

4) Watershed restoration projects intended to reduce erosion and fine sediment production and improve watershed connectivity and habitat.

5) Fish monitoring and research activities designed to evaluate and improve restoration activities.

Projects may have one or more major components which may affect listed species and/or their aquatic habitat including:

1. Heavy equipment operation in or adjacent to water
2. In-water excavation or dredging
3. Grading operations (in-channel or floodplain)
4. In-water gravel augmentation
5. Riparian vegetation removal or management
6. In-water work area exclusion and dewatering
7. Fish salvage and handling
8. In-water and adjacent pile driving
9. Fish passage-barrier removal or retrofit
10. Bank stabilization
11. Fish collection for study purposes
12. In-channel LWD and boulder placement.

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

1.3.1 Restoration Project Types

Restoration projects are grouped together by type and summarized below. Implementation of restoration projects may require use of heavy equipment including excavators and backhoes. Construction activities may occur at all times of the year outside of the Ordinary High Water Mark (OHWM). Construction on the floodplain (within the OHWM) may occur when not inundated (from May through December). Construction within the wetted river channel will be limited to between June 15 to October 15 for Trinity River tributaries and July 15 to October 15 for the Trinity River mainstem, with the use of best management practices (BMPs), such as anti-spawning mats after September 15 in construction areas that may be suitable spawning habitat. The majority of excavation and grading activities within the OHWM would occur between July 15 and October 15, though excavation and other activities on dry floodplain surfaces may begin earlier than June 15 (for tributaries) and continue later than October 15 as long as surface water runoff does not increase Trinity River turbidity by > 20 percent over background levels. Large, split-flow channel projects like Oregon Gulch and Sky Ranch may need to excavate outside the June 15 to October 15 window. Construction and revegetation activities on adjacent floodplains and riparian zones (outside the OHWM) may occur during from the summer through autumn months (between July and December). Upon completion of work, low-flow channel crossings will be dismantled and materials contoured to the original or restoration design during the in-water work period (July 15-October 15). Conservation measures for instream construction and water quality protection will be applied to all projects.

1.3.1.1 Channel Rehabilitation

The channel rehabilitation activities are designed to produce complex juvenile salmonid habitat and have evolved to require in-channel construction as previous efforts did not produce an immediate increase in rearing habitat or geomorphic response. This will involve use of heavy equipment in the channel, channel excavation, and grading of floodplains. Riparian vegetation may be removed to access sites or facilitate floodplain grading. Proposed projects include; construction of gravel and skeletal bars, construction of floodplain surfaces with elevations allowing periodic inundation, and removal of riparian berms with revegetation of restored flood plain surfaces. Extended in-water work periods, bedrock fracturing, structured log jams (SLJ) installation using pile-driving techniques, and site restoration and revegetation techniques, including alternate point bars, alcoves and side-channels, beaver dam analogues, and floodplain habitat, may also be required depending on the project. Bedrock fracturing may involve use of jack hammers or expanding grout. Fractured bedrock will be removed from the floodplain and side channel using excavators. The use of expanding grouts would be limited to applications outside the wetted channel or within areas isolated from the active channel. Heavy equipment operating in the water will employ slow, deliberate movement, which will allow most fish to disperse from the immediate work area. Channel rehabilitation activities associated with the TRRP are done in concert with scheduled flow releases from Lewiston Dam.

Some channel rehabilitation project sites may require temporary low flow channel crossings, which will consist of gravel fill materials or temporary bridges. The crossings will be constructed to maintain adequate water depths ($\geq$ 1 foot deep) and water velocities ($\leq$ 2 feet per second) over as much of the length of the crossing as possible to provide suitable conditions for adult and juvenile salmonid upstream and downstream passage (Bell 1990). A clean cobble/gravel mixture, with a high ratio of cobbles, will be used to create any in-channel crossing surface. Larger particle size will prevent attraction of spawning salmon to the crossing area. Upon completion of work these crossings will be dismantled and materials contoured to the original or restoration-design river bottom during in-water work period (July 15-October 15).

1.3.1.2 Fine Sediment Management

Fine sediment management will include streambank stabilization and the dredging of the Grass Valley Creek (GVC) sediment retention basin, known as Hamilton Ponds, located on Grass Valley Creek just off Lewiston Road in Trinity County. The need to dredge the ponds has decreased with restoration activities in the Grass Valley Creek watershed, but recent wildfires may release fine sediment into the watershed. The upper Hamilton Pond may require dredging every 5-10 years. If the upper pond is dredged, the lower pond may serve as slow water habitat and may not need to be dredged. Removal of fine sediment from these retention basins will be conducted between July 1 and October 15 over approximately two weeks.

Prior to dredging, GVC flows may be diverted into a bypass channel upstream of the upper pond. A properly screened pump may be used to lower the pond and fish are expected to leave to downstream areas away from the excavation zone or to avoid the area via the by-pass channel. Seines will be used to further push fish downstream out of the pond. Electrofishers would then

be used to remove any remaining fishes. The permeability of the alluvial substrate is such that some water remains in the pond during dredging activities. Silt curtains will be installed in a manner that "herds" fish away from the dredging area to be eventually surrounded by the curtain. Accumulated sediment will be removed with an excavator and disposed of in a manner such that spoils cannot return to the river.

Bank stabilization measures to control erosion may be implemented at channel rehabilitation sites or at other locations (such as private property where channel migration threatens domestic structures). Techniques to stabilize streambanks and reduce fine sediment input range from upslope erosion control activities to stabilizing stream banks with in-stream structures. The following streambank stabilization methods may be used individually or in combination: alluvium placement, large wood placement, vegetated riprap with large wood, engineered log jams, woody plantings, herbaceous cover in areas where the native vegetation does not include trees or shrubs, bank reshaping and slope grading, coir logs, deformable soil reinforcement. In addition to the limits and requirements stated below, all project designs must be consistent with industry-accepted bio-engineering design guidance, such as that found in California Department of Fish and Wildlife - Salmonid Restoration Manual (fourth edition) (CDFG 2010) or Washington State Aquatic Habitat Guidelines Program: Integrated Streambank Protection Guidelines (Cramer et al. 2003). Rock may be placed at the toe of the bank in addition to bioengineered features above the waterline.

The maximum linear length of streambank stabilized per individual project shall not exceed three-times the active channel width at the project site. To the extent feasible, use site design to retain natural vegetation, large wood, and permeable soils, limit compaction, and otherwise minimize the extent and duration of earthwork (e.g., compacting, dredging, drilling, excavation).

In addition, the following best practices apply to all projects in the program:

- No large woody debris (LWD) or trees will be removed in active (wetted) channels. Trees outside the wetted channel may be removed for access routes for construction equipment. If trees need to be removed from other portions of the project site, do not remove native riparian trees or shrubs over 3 inches in diameter at breast height or reduce canopy cover provided by hardwoods or conifers. Replant any trees removed to achieve 1:1 successful revegetation by one of the following methods: a) trees removed can be replanted at 3:1, or b) site can be monitored for 2 years and replanted until 1:1 successful revegetation is achieved.

- Limit new access routes requiring tree removal and grading to no more than two. Access routes should not be along the top of the stream bank but relatively perpendicular (45 to 90 degrees is acceptable) to bank.

- Where available, use existing ingress or egress points, or perform work from the top of the stream banks.

- No work during wet weather or where saturated ground conditions exist; if a 60% chance of a one half inch of rain or more within a 24-hour period is forecasted, then the site shall be treated with erosion control measures and construction operations will cease until 24 hours after rain has ceased. Petroleum products, chemicals, fresh cement, or water contaminated by the aforementioned shall not be allowed to enter flowing waters.

- Adequate erosion control supplies (gravel, straw bales, shovels, etc.) shall be stored on site.

- Any disturbed ground must receive appropriate erosion control treatment (mulching, seeding, planting, etc.) prior to the end of the construction season, prior to a cease of operations due to forecasted wet weather, and within seven days of Project completion. Operations will use all feasible techniques to prevent any sediment from entering a drainage system.

- Work pads, falsework, and other construction items will be removed from the 100 year floodplain by the end of the construction window.

- In areas expected or forecasted to get rainfall during the construction season, effective erosion control measures shall be in place at all times during construction activities. Construction within the 5-year floodplain may not begin until all temporary erosion controls (e.g., straw bales, silt fences that are effectively keyed in) are in place, downslope of project activities within the riparian area. Erosion control structures shall be maintained throughout, and possibly after, construction activities. Sediment shall be removed from sediment controls once it has reached one-third of the exposed height of the control. Whenever straw bales are used, they shall be staked and dug into the ground 12 centimeters (cm). Catch basins shall be maintained so that no more than 15 cm of sediment depth accumulates within traps or sumps.

- Based on a field geomorphic assessment, the channel bed and banks shall be re-contoured after construction to achieve the anticipated natural self-sustaining pool-riffle morphology to the extent feasible.

- To minimize the potential for cumulative sediment impacts in downstream habitat, projects constructed during the same field season must be separated longitudinally (i.e., upstream and downstream) by at least 350 meters.

The following activities are not covered under this programmatic opinion:

- Any action that constricts existing channel capacity.

- Any riprap revetment that extends rock above the streambank toe.

- Any riprap revetment that extends the use of riprap laterally into an area that was not previously revetted, if working on a previously hardened streambank stabilization site (e.g., previously used riprap, shotcrete, cement retaining wall, etc.).

- Any riprap revetment that does not include adequate vegetation and LWD.

- Any action that displaces riparian or aquatic habitats[1] (including submerged aquatic vegetation) or otherwise prevents development of natural habitat processes, to be determined by the Corps with technical assistance from NMFS.

- Any action that involves wing deflectors, stream barbs, or channel-spanning structures including weirs.

Other fine sediment management activities include mechanically reducing gully formations, installation of erosion control blankets, planting live stakes to increase floodplain roughness, grading banks to a stable slope and planting to increase stability, constructing vegetated soil lifts to stabilize slumping banks, and placement of wattles to reduce erosion. These activities will take place far from aquatic habitat and/or follow all applicable conservation measures.

In-channel work may require isolation from flowing water to control turbidity for a number of activities. Super sacks (large bags constructed of woven material and filled with a gravel/ sand mix) may be placed as coffer dams for streambank stabilization, bedrock fracturing, barrier removal, or channel construction and excavation. Water within the area of isolation will be removed with a properly screened pump meeting NMFS water drafting and fish screening guidelines and piped to an upslope area where it cannot return to the river. Prior to dewatering, fish will be removed by a qualified fish biologist within the area of isolation by seining then electrofishing according to conservation measures described under “Research and Fish Capture”.

1.3.1.3 Sediment Management

Annual coarse sediment augmentation in the Trinity River mainstem upstream of Indian Creek has been established and continues at five locations. High flow gravel injection at select Lewiston reach sites is proposed to occur between April and May, but may occur earlier as pre-peak flow floodplain placements. Additional locations are being considered, including but not limited to the vicinity of Bucktail Bridge and Steel Bridge campground. The gravel quantity recommended for augmentation varies by injection location and total augmentation targets are proportionally keyed to the Water Year Classification (Gaeuman 2014). Coarse sediment augmentation at most sites are expected to occur during high spring flows, when coarse sediment may be introduced to the river mechanically and be entrained by river flows. Injection areas would be of sufficient velocity to ensure that juvenile fish would not be holding in the vicinity.

1 Pertains to riparian impacts above and beyond those associated with equipment access to the project site. Equipment access impacts require tree replacement as detailed previously.

Coarse sediment augmentation requires the use of heavy equipment, such as excavators, bulldozers, scrapers, gravel conveyors, and dump trucks at injection sites. Gravel may be graded by bulldozers, excavators, and loaders into lateral bars along the riverbank for low-flow installations. During high-flow installations, gravel is often placed directly into the high-velocity current in the river channel from high banks. Conveyor belts cantilevered over the river may be used to extend the distance into the channel for injecting gravel at some sites. Gravel may be placed in the floodplain (below the OHWM) whenever flows allow so that recruitment to the river will occur with increased flows.

A brief description of the five primary locations for future long-term gravel augmentation is summarized from the TRRP Master Environmental Impact Report (NCRWQCB and Reclamation 2009) and the Gravel Augmentation Technical Report (Gaeuman 2014) as follows:

- Hatchery: This site is located adjacent to the Trinity River Hatchery (TRH) and is approximately 0.4 miles, located at RM 112.2 – 111.8, immediately downstream from Lewiston.

- Sven Olbertson (AKA Weir Hole, Diversion Pool, Lewiston Upstream): This site, located at RM 111.15, is located between Lewiston Dam and the New Lewiston Bridge.

- Cableway: The Cableway Reach, located between RM 110.18 and 110.46, is between the New Lewiston Bridge and the Old Lewiston Bridge in the center of Lewiston.

- Sawmill: The designation "Sawmill" refers to a channel rehabilitation site, as well as a high flow gravel augmentation location, located between RM 108.89 and 109.73.

- Lowden Ranch: "Lowden Ranch" designates two high-flow gravel injections sites located between RM 104.4 and 104.95.

Additionally, gravel augmentation may occur at other sites in the upper Trinity River and/or in shallow, low velocity back water areas during base flows. These sites may contain suitable habitat for juvenile coho salmon and fish will be herded out of these areas using seine nets prior to gravel placement. Work activity will pause if turbidity levels are exceeded during gravel placement at these sites. Fine sediment may also be injected during high flow in the reach extending from the Trinity River Hatchery to Sven Olbertson. This reach is located immediately downstream of Lewiston Dam and suffers from the highest degree of sediment starvation.

1.3.1.4 Watershed Restoration

Watershed restoration will include improving fish passage, instream habitat restoration, revegetation, instream flow restoration, road decommissioning, road maintenance, and road rehabilitation. All applicable conservation measures and BMPs will be applied to watershed restoration projects to avoid or minimize activity impacts on listed species.

Fish passage improvements include road crossing upgrades and removal and/or retrofitting barriers including small dams and diversions for upstream fish access. Upcoming barrier removal

projects are the Manzanita Creek fish migration barrier removal, East Weaver Creek Dam removal, and the Oregon Gulch Culvert replacement projects. The project along Manzanita Creek will remove a small dam that is a migration barrier. The East Weaver Creek project involves removal of a 20-foot tall dam. The Oregon Gulch culvert replacement project will remove a long standing barrier to fish migration where Sky Ranch Road crosses Oregon Gulch.

Habitat restoration actions along tributaries include installation of habitat elements such as large wood, in-stream boulders, and spawning gravel as well as larger in-channel and floodplain rehabilitation projects. Tree placement through helicopter and mobile ground-based methods do not require heavy equipment operation within the wetted channel compared to traditional in-channel placements. Channel and floodplain rehabilitation projects occur along degraded tributary reaches and may include channel construction, re-grading and/or the addition of weir-like structures, logs, and streambed substrate to facilitate passage and provide in-stream habitat. Lowering and reconnecting floodplain habitat may also occur. The proposed West Weaver Creek salmonid habitat rehabilitation, Sidney Gulch Forest Service compound fish passage restoration, and Lower Sidney Gulch urban stream restoration (Phase 2) projects will employ these methods.

Stage Zero is a relatively new process-based approach to channel restoration which may be used on upcoming projects, including the Indian Creek and Salt Creek drainages. This method can include construction of a Geomorphic Grade Line (GGL) based on geographic information system (GIS) and field-based analyses, basically filling incising channels and installing floodplain elements to provide roughness (Powers et al. 2018). In tributaries that lose surface flow during the summer months, such as Indian Creek and Salt Creek, work will take place in dry conditions.

Revegetation may occur as a stand-alone project and/or part of larger watershed restoration activities to reduce upslope erosion from past land management such as timber harvest, mining, and poor road construction. Watershed revegetation efforts in the Grass Valley Creek, Hoadley Gulch, and Indian Creek watersheds will target reducing sedimentation rates into the Trinity River to restore fisheries. Watershed revegetation efforts throughout the action area will focus on repairing degradation from past land management activities.

In-stream flow restoration from diversion projects will be designed to reduce water withdrawals especially during low flow conditions. Projects include: water conservation and efficiency outreach and education; monitoring to determine low flow thresholds; and designing, permitting, and implementing individualized water conservation systems. New systems may include more efficient intake hoses and low volume pumps, the installation of slow flow systems such as trickle fill, solar, and ram pumps, water storage, beaver dam analogues to raise water tables, stage zero GGL and restoration to raise water tables and other techniques to slow runoff, and full forbearance systems to eliminate stream withdrawal during lowest flow periods.

Road-cut, fill-slope and stream channel erosion, resulting from old, poorly engineered and maintained roads, is a TRRP priority. Road maintenance activities will include only work that would result in insignificant or discountable effects on coho salmon habitat (e.g., working in dry conditions), and may include grading, rocking and clearing of drainage structures on existing

roads. Road rehabilitation may include replacing undersized culverts with new culverts or bridges capable of accommodating a 100-year storm, associated debris, out sloping, rocking of roads, energy dissipaters, and the addition of new drainage structures to reduce the accumulation of water in inboard ditches. Road decommissioning could include the removal of stream crossing structures, culverts, Humboldt Crossings, and sometimes reshaping, ripping, seeding and mulching of the road surface, depending on slope, soil type and other conditions. Measures to minimize impacts to aquatic species for road related work includes working in dry conditions or in isolated waters.

A brief summary of currently proposed watershed restoration projects is listed below. Future projects will adhere to the suite of actions listed above and employ BMPs listed in the Proposed Action.

- Lower Supply Creek floodplain and fish habitat enhancement: The HVT proposes to remove 750 feet of levee confining Lower Supply Creek in addition to installing LWD and boulder structures. This will create 150 feet of new channel and reconnect Supply Creek to the floodplain and existing side channel and backwater habitat.

- Mainstem and South Fork Trinity road decommissioning: The Trinity County Resource Conservation District will excavate 3100 cubic yards of material from six stream crossings on 0.67 miles of two U.S Forest Service roads. After excavation, rocks and LWD will be placed in-channel and riparian areas planted with native vegetation.

- Weaver Creek restoration planning: The Yurok Tribe proposes to complete this project proposed by the Nor-Rel-MukWintu. Channel rehabilitation and sewer pipe barrier removal at the confluence of East Weaver and Weaver Creeks. Berms and road beds along approximately 1.5 miles of stream will be removed to encourage lateral floodplain connectivity and reduce stream power. Associated fine sediment accumulation is expected to aid in water retention and alleviate seasonal low flow barriers.

- Mill Creek sediment management: The HVT will implement road related sediment management treatments at; 14 stream crossings, 2 landslides, 1 ditch relief culvert, and on 13.3 miles of unpaved road within the Mill Creek watershed.

- Heliwood Phase II: The Yurok Tribe will increase habitat quality for spring-run Chinook salmon by placing whole trees in the channel of the upper South Fork Trinity River.

- Indian Creek habitat connectivity phase II: The Yurok Tribe will restore aquatic connectivity on a section of Indian Creek by raising the groundwater table (Stage zero

GGL). This action will remove a low-flow barrier and restore access to spawning and rearing habitat.

1.3.1.5 Infrastructure Modification

Infrastructure modifications and improvements include limited bridge replacement and the Well Grant Program to mitigate for adverse effects of restoration flows on private riverside landowner's water supplies. All applicable conservation measures and BMPs will be applied to infrastructure modification projects to avoid and minimize impacts on listed species and their habitat.

1.3.1.6 Monitoring and Research

TRRP supports and/or conducts fish research and monitoring activities including: snorkel surveys; fish collection through various means such as electrofishing, seining, collection at rotary screw traps or existing weirs, minnow trapping, and hook-and-line capture; acoustic tagging and biotelemetry, and passive integrated transponder (PIT) tagging; external marks (e.g. floy tags, photonic paint), fin clips, spawner surveys, carcass surveys and tissue sampling. Projects may also include holding captured fish to assess factors such as growth and survival relative to biotic processes like water temperatures and food availability. TRRP research activities on listed salmonids currently is permitted under the authority of an ESA Section 10(a)(1)(A) Scientific Research Permit (Permit 17877 and 17877-2A). The existing permit expires December 31, 2020, and Reclamation proposes to continue these research activities and other studies under this section 7 consultation.

There are currently five studies to monitor restoration effectiveness:

1. Trinity River, Willow Creek and Pear Tree Trapping Sites. Data are being collected to assess juvenile salmonid production and emigration target dates. Rotary screw traps would run year-round at both locations with an emphasis on data collection between February and August.

2. Restoration site surveys (snorkel/dive) between Lewiston Dam and the Trinity River North Fork. Direct count snorkeling methods are used to estimate spatial and temporal differences in relative abundance of juvenile Chinook salmon within the approximately 40 mile (64 km) restoration reach.

3. Monitoring will occur from early September through mid-December to estimate total natural mainstem spawning escapement and temporal and spatial response of spawning to restoration over time. This study conducts annual monitoring of Chinook Salmon redd and carcass abundance and distribution in the mainstem Trinity River and selected tributaries from Lewiston Dam to the Klamath River confluence.

4. Researchers propose to use Passive Integrated Transponder (PIT) tags inserted into juvenile coho salmon to determine the overwintering strategy of Trinity River

coho salmon and extent of juvenile coho salmon use at specific study sites being monitored by PIT equipment. This study will take place from April to December in the Trinity River and tributaries from Lewiston Dam to Weitchpec (Klamath confluence). Up to 3,000 juvenile coho salmon per year will be tagged and PIT monitoring stations will be installed.

5. Snorkel surveys and trapping (fyke, minnow, and seine nets) will take place in the Trinity River and tributaries from Lewiston Dam to Weitchpec (Klamath confluence) from April to October and be used to determine presence and abundance of salmonids. This study may include electrofishing to increase the reliability of monitoring and collection methods, ensuring the most accurate counts possible.

Additional proposed studies include mark-recapture projects to determine the relationship between flow release timing and outmigration timing by juvenile salmonids, and to establish a causal link between outmigration timing and juvenile survival. This study may involve the implantation of PIT tags in out-migrating fish captured at screw traps and recapture in the lower Trinity River, lower Klamath River and/or the Klamath River estuary. TRRP may fund a cage study investigating the effect of engineered side channel habitat on growth rate of juvenile salmonids. Juvenile Chinook salmon will be paced in paired cages in the mainstem and side channels and later collected via netting or electrofishing. Juvenile coho salmon present in adjacent habitat will be free to avoid the effects of electroshocking and cages will prevent entry and exposure to capture and handling. These and any additional future proposed studies will include the same conservation measures (described below) employed in ongoing activities to reduce adverse effects.

1.3.2 Sideboards, Conservation Measures, and Best Management Practices

1.3.2.1 Upper Limits

Maximum project implementation levels are based on current practicality, funding, and short-term implementation effects to listed fish species. Annual project limits are expected to prevent cumulative impacts to water quality (sediment, turbidity, and water temperatures) and fish populations in the watershed.

A maximum of four mainstem channel restoration projects per year will take place based on funding and other factors. Project sizes vary and include wood placements, alcoves, channel and floodplain and upland re-contouring, side channel and wetland construction, riparian impacts and revegetation, and associated construction activities. Up to six locations will be used per year for coarse gravel augmentation. Up to 8,000 cubic yards (cy) mobile gravel may be added in a single year. Mechanical removal of fine sediment from Hamilton ponds will take place up to once every 5 years. Six restoration monitoring and effectiveness studies will be conducted per year. One bridge replacement will be allowed annually. The following are limits on instream watershed restoration projects annually:

- 2 Fish Passage/Dam removal projects
- 8 Channel/floodplain rehabilitation projects (4 mainstem and 4 tributary)
- 2 In-stream habitat enhancement projects
- 3 Streambank stabilization projects
- 4 Road related projects per year with in-water activities (i.e. de-commissioning with culvert removal).

1.3.2.2. Conservation Measures (CM)

The Biological Assessment submitted by TRRP (TRRP 2019) lists 85 detailed conservation measures common to all ongoing and proposed TRRP activities. A synopsis of measures pertinent to activities that may impact listed species or habitat is provided below.

Instream Construction

CM-8—Restoration, construction, fish relocation, and dewatering activities proposed within any wetted or flowing channel of tributaries to the Trinity River shall be restricted to the dry season (June 15 to October 15 for tributaries and July 15 to October 15 for the mainstem), before listed coho salmon begin spawning in tributaries. Work in intermittent streams may continue beyond November 1, as long as weather conditions permit, and the stream channel remains dry. Construction and restoration work within intermittent stream channels must be completed in the dry.

CM-10—Passage will be provided for any adult and juvenile fish likely to be present in the project area during construction, unless passage did not exist before construction or where the stream reach is naturally impassable at the time of construction. After construction, and where appropriate, adult and juvenile fish passage that meets NMFS's fish passage criteria (NMFS 2011c) shall be provided for the life of the project.

CM-18—To avoid pile driving impacts, only wooden piles will be used for SLJ placement below the OHWM. Wooden piles may be driven by an excavator, or when needed, a vibratory pile driver will be used in preference over an impact driver.

CM-22—If seining, dip-netting, or trapping of fish is infeasible or otherwise ineffective, electrofishing may be used to capture fish from isolated work areas under the supervision of a qualified fish biologist. Electrofishing will primarily be used to ensure fish removal (salvage) from areas where construction will otherwise result in the death of fish that are not removed. NMFS's (2000b) electrofishing guidelines shall be followed. If possible, electrofishing shall not occur when water temperatures are greater than 64°F (18°C) or are expected to rise above this temperature prior to concluding fish capture. No electrofishing shall be conducted in the vicinity of spawning fish or active redds. If fish mortality occurs, capture shall be immediately discontinued (unless this would result in additional fish mortality) until current procedures are

re-evaluated and any necessary adjustments are made to prevent or reduce further injury and mortality.

CM-23—When diverting flow around a work site is necessary (e.g., via pump, bypass culvert, or waterproof lined ditch) pumps shall be screened to prevent fish entrainment and culvert outfalls shall be fitted with energy dissipation devices to prevent damage to riparian areas and streambeds. Suction pump intakes shall be fitted with fish screens that meet CDFW and NMFS (NMFS 2001) criteria to prevent entrainment or impingement of small fish. If diversion allows for upstream and downstream fish passage, place diversion entrances in locations to promote safe entry and reentry of fish to stream channels, preferably in pool habitat with cover. When necessary, pump turbid seepage water from dewatered work sites for disposal into upland locations, where it will not drain directly into any stream channel or where suspended materials will be filtered before flowing back into the stream.

Water Quality

CM-25—All provisions of the TRRP's current CWA section 401 water quality certification shall be followed, including meeting turbidity thresholds during project construction (i.e., ≤20 Nephelmetric Turbidity Units (NTU) at 500 feet downstream of in-river construction when background turbidity is ≤20 NTU; and ≤20 percent increase in turbidity above background at 500 feet downstream when background is >20 NTU). If standards are not met, construction activities will cease until operations or alternatives can be completed within compliance standards.

CM-26—When appropriate to meet water quality objectives, construction areas shall be isolated from flowing water until project work is complete. Isolation methods include but are not limited to silt curtains, and sandbag cofferdams.

CM-27—Bedrock fracturing within the active river channel shall be conducted in an enclosure coffered with sandbags and dewatered using submersible pumps, when necessary. Sandbags and other temporary barriers will be erected surrounding the bedrock-fracturing work area to contain flying rock fragments.

CM-28—Effective erosion control measures shall be in place at all times during construction. These devices shall be in place during and after construction activities to minimize fine sediment input to flowing water and to detain sediment-laden water on site. If continued delivery of sediment to the waterway is likely to occur after construction is complete, appropriate erosion prevention measures shall be implemented and maintained until risk of erosion has subsided.

CM-31—Sediment-laden water created by construction activity in upslope areas, floodplain terraces, and dewatered work areas shall be directed to temporary storage and treatment sites (e.g., settling pond or Baker tank) or into upland areas to allow water to filter through vegetation prior to reentering stream network or other aquatic areas.

CM-38—Where slope protection is needed along rocky banks, stream bank stabilization measures, such as toe-of-rock slope protections, shall be placed below the bed scour depth to ensure stability.

Riparian Vegetation

CM-45—Project designs will create suitable conditions for riparian vegetation recovery over an area that is, at least, as large as areas impacted by restoration construction activities. Current mitigation compliance requires recovering an area equivalent to the area of impacted riparian habitat within 10 years of impact.

CM-46—Project designs will identify and use access routes and staging areas that minimize disturbance to riparian and wetland areas without affecting less stable areas. Prior to construction, equipment access routes shall be marked that minimize riparian disturbance and avoid entering unstable areas.

CM-47—Project designs shall retain upslope trees and brush, as feasible, emphasizing shade-producing and bank stabilizing trees and brush in these areas.

CM-50—To minimize disturbing areas of riparian vegetation and to minimize soil compaction, use equipment with the greatest practicable reach and minimize adverse impacts on soils (e.g., hand tools, minimally sized, low-pressure tires, minimal hard turn paths for tracked vehicles, temporary mats or plates within wet or sensitive soils).

CM-52—If feasible, re-use harvested trees for habitat restoration purposes (e.g., wood installation in the stream channel).

CM-55—Barren areas identified for revegetation shall be seeded and mulched, planted with a combination of willow stakes, native shrubs and trees, and/or erosion control native grass mixes.

CM-56—Native plant species shall be used for revegetation of disturbed and de-compacted areas.

Research and Fish Capture

CM-60—Reclamation or partners must handle listed fish with extreme care and keep them in cold water to the maximum extent possible during sampling and processing procedures. When fish are transferred or held, a healthy environment must be provided; e.g., the holding units must contain adequate amounts of well-circulated water. When using gear that captures a mix of species, the permit holder must process listed fish first to minimize handling stress.

CM-61—Researchers must stop capturing and handling listed fish if the water temperature exceeds 70 degrees Fahrenheit at the capture site. Under these conditions, listed fish may only be identified and counted. Electrofishing is not permitted if water temperatures exceed 64 degrees Fahrenheit.

CM-66—Backpack electrofishing equipment must comply with NMFS Backpack Electrofishing Guidelines.

CM-67—Electrofishing is not permitted if listed adult salmon or adult steelhead are present. The researcher/monitoring agency must avoid listed adult salmon and steelhead. Any listed adult salmon or steelhead encountered while electrofishing must be reported in the annual report.

CM-69—Reclamation must notify NMFS as soon as possible but no later than two days after any level of take is exceeded or when exceedance is imminent. The researcher/monitoring agency must submit a written report detailing why the take level was exceeded or is likely to be exceeded.

CM-71—Researchers in the field must carry a copy of these conservation measures/conditions while conducting the authorized activities.

CM-72—Reclamation or partners must allow any NMFS employee or representative to accompany field personnel while they conduct the research activities.

1.3.2.2 Best Management Practices (BMPs)

TRRP proposes a number of BMPs for restoration activities. The following is a list of measures pertinent to activities that may impact listed species or habitat.

- Clearing and grubbing of vegetation would be limited to the period from August 1 to March 14. Vegetation removal and other site preparation may occur sooner if the absence of nesting birds has been determined.

- Existing roads would be used to access the activity areas, where available. New access roads and haul routes would be constructed, when necessary, and restored to a stable condition in accordance with appropriate landowner/manager requirements at the completion of the project.

- Floodplain excavation and terraforming would bring riparian surfaces to design grades.

- Quality resource material found during construction (e.g., quality soils, woody material, sand, trees, etc.,) may be stockpiled for use at in construction use areas located in upland or other activity areas.

- At project completion, riverine treatment areas (e.g., constructed inundation surfaces) that were compacted from construction activities will be ripped to a depth of approximately 18 inches. Terraforming to increase onsite infiltration will be completed

- The timing for work adjacent to the river may be affected by river flows. If for some reason the flow is low when construction starts, but it is anticipated that flows will increase before the floodplain can be excavated, excavation would occur at the lower elevations (adjacent to river) first and at the higher floodplain elevations last. In cases

where flows will be increased and will scour recently constructed surfaces, BMPs will isolate the work areas only against summer base flow conditions.

- Alcoves and side channels will be constructed from the existing grade to lower elevations. Measures will be taken (e.g., sediment plug, sandbags) to isolate work areas from flowing water. If necessary, pumps will be used to dewater excavation zones to control turbidity levels entering the river. Reconnecting these features to the river relies on water management so that downstream turbidity levels remain below 20 NTUs at 500 ft below construction activities. The TRRP will remove materials used to isolate these side channels after they have been constructed.

- Activity areas will be seeded and mulched after final grading.

- Post-project revegetation will take place during wet conditions (fall/winter) and will generally occur in riparian areas to maximize use by fish and wildlife species. At a minimum, impacted areas approximately 3 foot above the low river water elevation will be seeded and mulched post construction. Where appropriate, revegetation efforts will be also be implemented to establish native vegetation in upland spoils areas. Projects are generally designed and implemented to achieve no net loss in riparian vegetation (within the project site boundaries) from planting and natural revegetation.

Construction compliance monitoring will occur prior to and during construction to ensure compliance with environmental commitments, including:

- pre-construction mapping and quantification of wetlands and riparian vegetation;

- fencing and marking of vegetation and other habitat features that are to remain undisturbed and protected, or used as salvage material, during construction, and periodic inspection during construction to ensure regulatory compliance;

- during in-water work by heavy equipment, inspections of shallow water areas in order to carefully displace any juvenile salmonids, allowing them to redistribute under their own volition, away from work sites;

- salvage, transport, and release of fish, including ESA-listed SONCC coho salmon, and sensitive herptofauna (amphibians and reptiles) from work locations to the main river channel or other safe locations in the vicinity outside construction areas; and

- All in-water work must comply with conditions of the TRRP's programmatic CWA Section 401 Water Quality Certification and federal water quality objectives in the Water Quality Control Plan for the North Coast Region (Basin Plan; NCRWQCB 2011). During in-water construction activities, sediment and turbidity levels are monitored to avoid increasing turbidity over 20 NTUs above background levels in order to protect the Trinity River's "beneficial uses". The TRRP will also monitor turbidity released from channel rehabilitation sites during the first post-construction high flow.

- Construction of side channels, split-flow conditions, new river meander bends, wetlands, and placement of large wood and skeletal bar features all require isolation of low-flow construction features and control of water releases and turbidity.

Post-construction monitoring includes:

- One-to-one areal riparian replacement goals are achieved when monitoring within 10 years of project implementation measures that the spatial extent of functional riparian vegetation recovery areas (the sum of planted and natural recovery areas) is greater than the impacted riparian vegetation area.

- Monitoring, evaluation, and reporting of coarse sediment movement and deposition patters will be completed by the Program.

1.3.3 Project Inclusion Process

As the lead Federal agency, TRRP funded projects that are consistent with the TRRP biological assessment (BA) will be covered by this Programmatic Biological Opinion (BO). Also, as the federal lead agency, TRRP will be able to adopt restoration actions that are not funded or implemented by TRRP or the participating federal agencies as long as those projects are consistent with the TRRP BA and Programmatic BO, including project limits and the amount or extent of incidental take. Any remaining project allocation and incidental take exemption identified in the TRRP Programmatic BO can be used by the participating federal action agencies. Because there are 4 federal participating agencies other than TRRP (USFWS, USFS, BLM, and the ACOE), coordination among the agencies is required to ensure that the prospective projects are consistent with the TRRP Programmatic BO, and that the project limits and amount or extent of incidental take are not exceeded. The TRRP will be the lead in presenting to NMFS which projects are being proposed for inclusion into the TRRP Programmatic BO. Before presenting to NMFS a set of projects for inclusion for the year, TRRP will coordinate with the participating agencies to ensure that all proposed projects are coordinated.

Project Notification

The following describes when projects should be brought forward for annual interagency coordination and pre-implementation review to determine when project information will be shared with NMFS. Annual interagency coordination will occur as needed and will focus on tracking TRRP accomplishments from the previous year, and determining priority restoration, monitoring and research activities for the upcoming season. All projects that are greater than a no effect will be considered annually during interagency coordination and tracked in the annual report to NMFS on TRRP Programmatic BO projects, but not all projects will require pre-construction notification, as described below.

1. Notification Not Required

Projects that have either no effect or an extremely low anticipated effect (based on type of project, proximity and potential for aggregated effects) to listed species and their habitat would not need to be brought forward during the annual interagency coordination.

2. Notification Not Required Prior to Implementation

Projects considered to be 'not likely to adversely affect' do not require notification to NMFS prior to implementation, but will require tracking and reporting. These projects may have some insignificant or discountable level of effect, positive or negative, and do not result in take of a listed species or adverse effects to critical habitat. Projects may be located within or near listed species habitat. These projects do not require notification prior to construction but will require tracking by watershed and will be shared during interagency coordination for tracking activities, and will be included in the annual report of TRRP Programmatic BO projects that is provided to NMFS.

3. Notification Required Prior to Implementation

Projects that have the potential (based on proximity, probability and magnitude analysis or stressor/response analysis) to result in a "may affect, likely to adversely affect" determination to listed species or designated habitat will require notification prior to construction (during interagency coordination and before construction begins) and will also be included in the annual report of TRRP Programmatic BO projects. Reported projects would include:

- Any project that involves listed fish handling or potential for harm (e.g., displacement, etc.) to occur due to type of action and/or actions occurring near or within occupied habitat.

- Projects that may result in significant sediment delivery or turbidity, temporary change in flow conditions, or species disturbance, if the changes to habitat or disturbance to species cannot be discounted (i.e., determined to be at the likely to adversely affect level) and the project results in a long term benefit to aquatic ecosystems.

- Projects that may involve temporary change in flow conditions, or in the case of improving water diversion locations, involve setting minimum flows that could affect fish movement or cool water refugia.

- Any project that involves full spanning structures or engineered projects in habitat occupied by listed species.

- Any projects proposing extensions to the work window.

- Projects that involve streambank stabilization or in-channel excavation.

Projects that result in a solely negative effect (without long term benefit to species or habitat) are not included in the TRRP Programmatic BO and will require separate project consultation. Projects that will have no effect on listed fish do not require ESA coverage and will not be formally included in the TRRP Programmatic BO reporting.

The following information will be provided to NMFS for all projects included in the TRRP Programmatic BO that are above the no effect level. The TRRP may request the participating federal agencies to provide the TRRP the same information for the TRRP's review for consistency with the TRRP Programmatic BO, and ensuring that the amount or extent of incidental take is not exceeded. The need for post project compliance monitoring will be identified based on the information provided during project notification. A Project Notification Form should include the following information:

a. Project Name – Use the same project name from notification to completion (i.e., Jones Creek 2015 Culvert replacement).

b. Location – watershed/stream name, and latitude and longitude (decimal degrees) or map

c. Agency Contact – Agency and project lead name

d. Timing – Project start and end dates, potential need to work outside of the work window

e. Activity Type

f. Project Description – brief narrative of the project and objectives

g. Extent – number of stream miles or acres to be treated and miles of habitat benefited

h. Fish Information

    i. Species affected

    ii. Distance to occupied habitat

    iii. Fish handling required (seining/block net/electrofishing/dewatering)

i. Verification – verification that all appropriate Conservation Measures, Project Design Criteria, and BMPs listed in the TRRP BA have been thoroughly reviewed and will be incorporated into project design, implementation, and monitoring as appropriate based on project specifics. The interagency coordination team may request additional verification dependent on the scope and scale of the project.

j. Effects determination of project

k. Project lead fish biologist's signature.

Project Implementation

Projects not requiring any notification or any notification prior to implementation can proceed with implementation so long as all federal, state, and local permit conditions are met. Projects requiring notification will require NMFS confirmation that they are consistent with the TRRP Programmatic BO.

Project/Program Monitoring and Reporting

The TRRP will monitor and report on projects implemented under the TRRP Programmatic BO for TRRP-funded projects and for restoration projects in the action area (i.e., Trinity River watershed for restoration projects and Trinity River watershed and the Lower Klamath River watershed for monitoring and research) that the TRRP adopts into the TRRP Programmatic BO. Participating federal action agencies that use the TRRP Programmatic BO for restoration actions in the action area will be responsible for monitoring and reporting. Where the TRRP funds a participating federal agency on a restoration, monitoring or research project, the TRRP may delegate the monitoring and reporting requirements to the participating federal agency. As the federal lead agency, the TRRP will be responsible for collating all the monitoring and reporting to NMFS.

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.

Reclamation has determined that the proposed action is not likely to adversely affect the distinct population segment (DPS) of Southern Resident Killer Whales, the southern DPS of eulachon, the southern DPS of North American green sturgeon, or the southern DPS of eulachon critical habitat. Our concurrence is documented in the "Not Likely to Adversely Affect" Determinations section 2.12.

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 as a whole for the conservation of a listed species" (50 CFR 402.02).

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

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

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

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

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of SONCC coho salmon 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

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.

2.2.2 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 (McElhany 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 2014) 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 1940s (CDFW 1994). 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 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. A viable ESU contains populations that exist as a metapopulation that as an entity is naturally self-sustaining into the foreseeable future, no longer needs the protection of the Endangered Species Act, and therefore can be “delisted” – taken off the list of threatened and endangered species.

2.2.2.2 Status of SONCC Coho Salmon Critical Habitat

An important factor affecting the range wide status and aquatic habitat at large is climate change. Information since SONCC coho 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 listed salmonids subject to this consultation. In the coming years, climate change will reduce the ability to recover some salmon species in most or all of their watersheds. Coho salmon are particularly vulnerable to climate change due to their need for year-round cool water temperatures, as they rear for one or more years in freshwater, unlike some other salmonid species (Moyle 2002). By increasing air and water temperatures, climate change is expected to decrease the amount and quality of habitat coho salmon, reducing the productivity of populations and exacerbating the decline of the species. 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 1960’s, 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 possibly a 50-80 cm rise by the end of the 21st century (IPCC 2019). This rise in sea level will alter the habitat in estuaries and either provide 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. 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 salmonids in Northern California, including SONCC coho salmon.

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

The factors that caused declines 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 of SONCC coho salmon (Good et al. 2005). From 2014 through 2016, the drought in California reduced stream flows and increased temperatures, further exacerbating stress, disease, and decreasing the quantity and quality of spawning and rearing habitat available to SONCC coho salmon. Ocean conditions have been unfavorable in recent years (2014 to present) due to El Niño conditions and the warm water "Blob" which impacted the U.S. west coast, and reduced ocean productivity and forage for SONCC coho salmon.

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 includes the entire Trinity River watershed encompassing all stream channels, riparian areas, and hydrologically linked upslope areas that will be affected by implementation of the restoration action (Figure 1). In addition, the action area includes the Lower Klamath River watershed for fisheries research and monitoring activities occurring there (Figure 2).

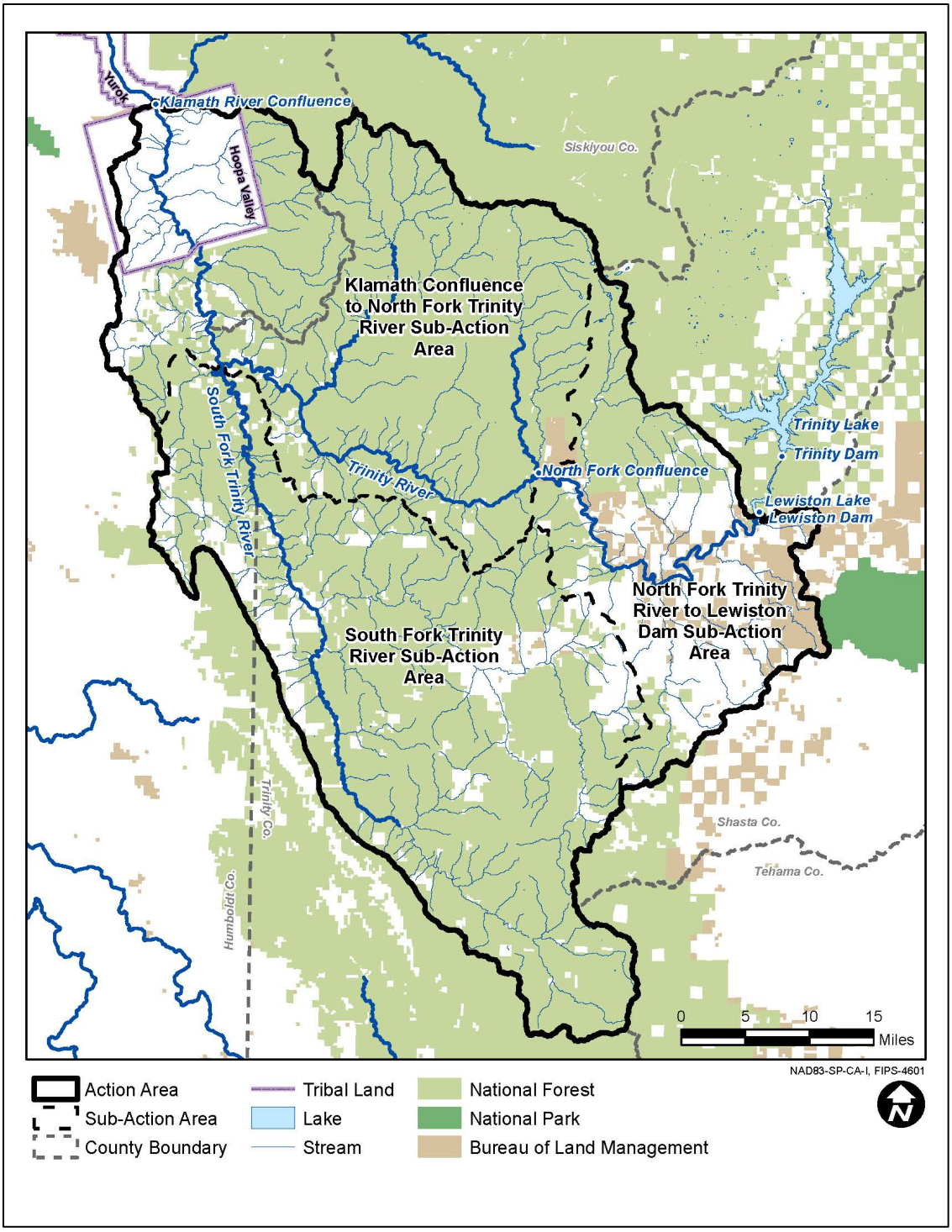

Figure 1. Map of the Trinity River Restoration Program's action area in the Trinity River from Lewiston Dam to the Klamath River confluence and the South Fork Trinity watershed.

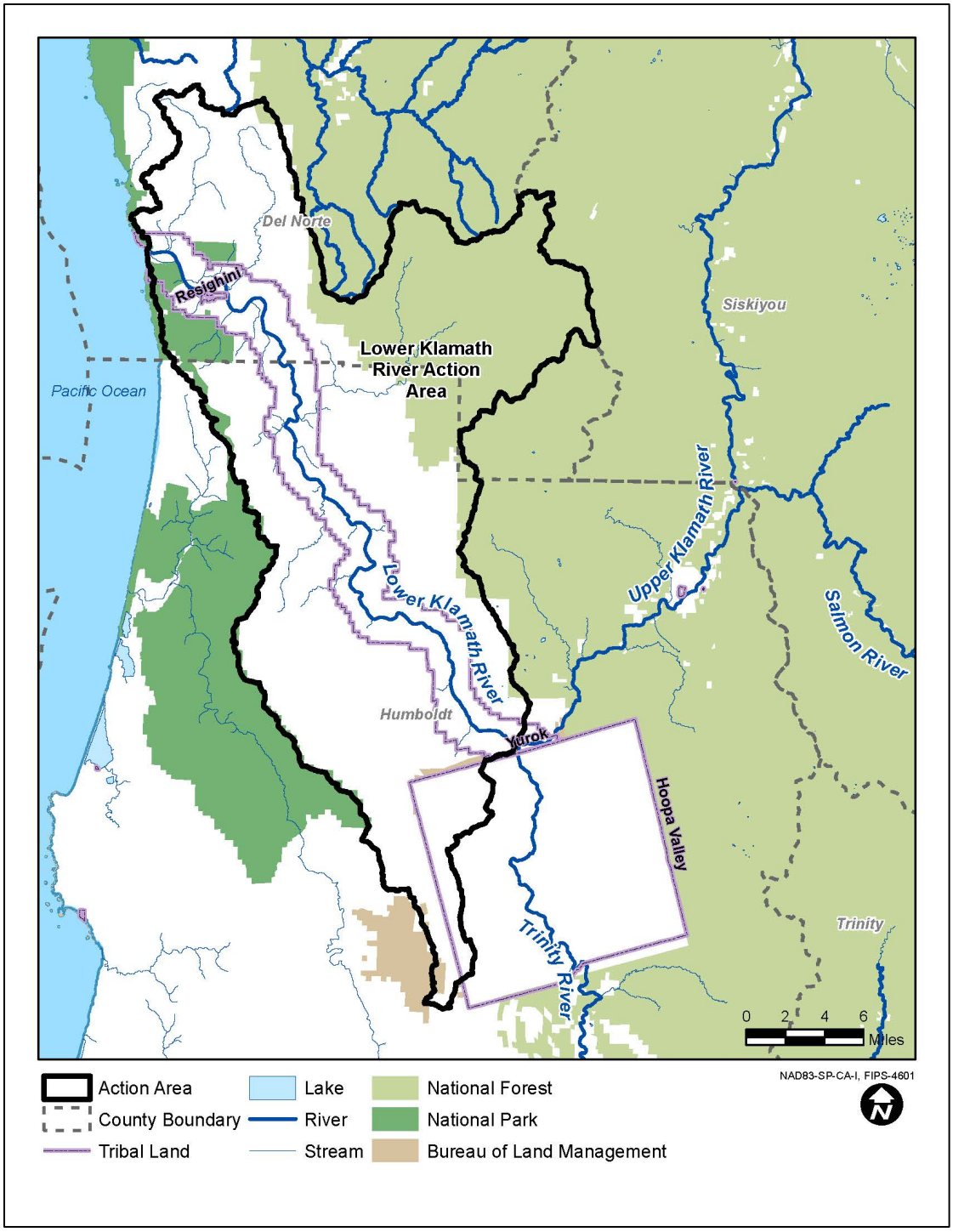

Figure 2. Trinity River Restoration Program's monitoring and research area in the Lower Klamath River watershed (fisheries research/monitoring only).

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 SONCC Coho Salmon Population Units in the Action Area

There are three Trinity River population units in the action area (Table 1).

Table 1. SONCC coho salmon populations in the action area and their spawner abundance for recovery (NMFS 2014).

Population Unit	Boundaries	Adult population needed for ESU recovery
Upper Trinity River	Confluence of North Fork Trinity River (inclusive) upstream to Ramshorn Creek (inclusive).	5,800
Lower Trinity River	Confluence of Klamath River upstream to confluence with North Fork Trinity River (non-inclusive).	3,600
South Fork Trinity River	South Fork Trinity River to the confluence of the Trinity River.	970
Lower Klamath River	Mouth of Klamath River upstream to confluence with Trinity River.	5,900

The Upper Trinity River and Lower Trinity River Population Units are "core" population units, and need to achieve a robust level of adult spawners for recovery of the ESU (Table 1; NMFS 2014). The South Fork Trinity River Population Unit is not considered a core population unit, and needs to achieve only an amount of adult spawners required to be functionally independent for the recovery of the ESU (Table 1; NMFS 2014). Therefore, the Action Area is very important to the survival and recovery of the ESU because the ESU cannot recover without three of the four population units in the Action Area being recovered.

Population units in the Trinity River have a high conservation value. As mentioned above, at least two of them must be viable for the diversity stratum to be viable and for the ESU to be

viable. The Upper-Trinity Population unit is unique within the Trinity River system as these coho salmon are currently the longest migrating adult coho salmon in the stratum. While coho salmon likely used to migrate as far as Hayfork Creek on the South Fork Trinity River, habitat degradation and water utilization on that river has restricted the spatial structure of the population unit. The run timing of the Upper Trinity River population unit is earlier (September and October) than those fish in the Lower Trinity Population unit (November through January). Within the Interior-Trinity diversity stratum, the Upper Trinity River population unit and the Lower Trinity River population unit capture both the coastal winter returning run timing and the inland fall returning run timing. This aids in protecting the diversity stratum from both drought and flood by extending the time during which adults enter the Trinity River. The upper Trinity River population unit may serve as an important "source" population for the Lower Trinity and South Fork Trinity populations which may act as "sinks." The Upper Trinity River population unit also protects the ESU against range shrinkage by maintaining an inland population that is one of the furthest east migrating population units in the ESU. The discharge of the Lower Trinity River is more dominated by rain while discharge of the Upper Trinity River is more of a rain-snowmelt mix. These population units have developed different life history strategies to take advantage of this difference.

2.4.2 Status of SONCC coho salmon in the Action Area

Limited information about the population size of individual SONCC coho salmon population units within the action area is available. No systematic surveys that monitor population sizes in any of the populations are performed. CDFW monitors coho salmon run size at a weir near Willow Creek, California on the lower Trinity River. Because adult coho salmon from all three population units of the Interior-Trinity Diversity Stratum pass through the weir site due to its location, it is not known which population of coho salmon is captured at the weir. As such, the weir estimates provide an aggregate population estimate for all unmarked coho salmon upstream of the weir. All coho salmon marked by maxillary bone removal captured at the weir are known to be of 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 (Kier et al. 2017). The reduced production at TRH also changed the number of returning TRH origin coho salmon in recent years. 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 (Kier et al. 2017).

Upper Trinity River Population Unit

The Upper Trinity River population is at moderate risk of extinction as described in the SONCC coho salmon salmon recovery plan (NMFS 2014). 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. This population needs to have adult returns of 5,800 for the SONCC coho salmon ESU to be viable as described in the SONCC coho salmon salmon recovery plan (NMFS 2014).

Lower Trinity River Population Unit

Limited data exists for this 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 population growth rate in Lower Trinity River sub-basin has not been quantified. The Lower Trinity population is at high risk of extinction as described in the SONCC coho salmon recovery plan (NMFS 2014). This population needs to have adult returns of 3,600 for the SONCC coho salmon ESU to be viable as described in the SONCC coho salmon recovery plan (NMFS 2014).

South Fork Trinity River Population Unit

The only population estimates for the South Fork Trinity River are based on work by Jong and Mills (1992) who estimated that 127 adult and jack coho salmon returned to the South Fork Trinity River in 1985 and 99 returned in 1990. With 35.8 percent (46) of the adult coho salmon captured in 1985 being of hatchery origin, the total wild population was likely under 100 adults during these years (Jong and Mills 1992). However, in other years, few or no hatchery coho salmon were trapped on the South Fork Trinity River (Jong and Mills 1992). Although we have no current population estimates, if we assume abundances are similar to those found in 1985 and 1990, the South Fork Trinity River population does not meet the depensation threshold of 242 adults and is at high risk of extinction. The population growth rate in South Fork Trinity River basin has not been quantified but is likely negative based on loss of habitat and declining water quality. The South Fork Trinity River population is at high risk of extinction as described in the SONCC coho salmon salmon recovery plan (NMFS 2014). This population needs to have adult returns of 970 for the SONCC coho salmon ESU to be viable as described in the SONCC coho salmon salmon recovery plan (NMFS 2014).

Lower Klamath River Population Unit

NMFS (2014) determined that based on criteria established by Williams et al. (2008), the Lower Klamath River population is at high risk of extinction because the spawner abundance has likely been below the depensation threshold of 205 adult coho salmon. The productivity of the population, based on the limited information available, appears to be declining (NMFS 2014). This population needs to have adult returns of 5,900 for the SONCC coho salmon ESU to be viable as described in the SONCC coho salmon recovery plan (NMFS 2014).

2.4.3 Status of SONCC Coho Salmon Critical Habitat in the Action Area

Upper Trinity River Population Unit

The Trinity River Division of the Central Valley Project has caused loss of hydraulic function, habitat loss, and habitat simplification. The juvenile life stage of the Upper Trinity River population unit of SONCC coho salmon is the most limited of the life stages 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 water storage and flow management 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 base flows in the summer and fall months, contributing to low flow 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. Floodplain disconnection and poor riparian function as a result of reduced flow and variability is being addressed through restoration efforts but will continue to be a limiting factor for the population.

Lower Trinity River Population Unit

There is no critical habitat on the Hoopa Valley Tribe Reservation, which is located in the lower Trinity River area. Lack of floodplain and channel structure impacts has a major impact on the productivity of this 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.

South Fork Trinity River Population Unit

The South Fork originates in the North Yolla Bolly Mountains about 50 miles southwest of Redding and runs northwest for approximately 90 miles before reaching its confluence with the Trinity River. A large portion of the South Fork Trinity River watershed is publicly owned and managed by the Shasta-Trinity National Forest. Much of the basin is still recovering from the effects of the 1964 flood that introduced massive volumes of sediment into the South Fork

Trinity River and most tributary reaches. Due to the substantial sediment influx, much of the mainstem South Fork Trinity River and Hayfork Creek still lack deep pool holding habitat for adult salmon (NMFS 2007). In addition, temperatures in the lower South Fork and selected tributaries, particularly the lower portion of Hayfork Creek, have been implicated as being too high to fully support salmon. Deforestation, dewatering, illegal grading, and pollution associated with cannabis farming has significantly altered water quality and fish habitat in this population unit.

Lower Klamath River Population Unit

There is no designated critical habitat for this population unit, as the population boundaries lie entirely within the Yurok Tribe Reservation. Altered sediment supply, lack of floodplain and channel structure, degraded riparian forest conditions and impaired estuary function are the biggest stresses to this population. The juvenile life stage is most limited and quality winter rearing habitat, as well as summer rearing habitat, is lacking for the population. Juvenile summer rearing habitat is impaired from subsurface flow conditions in the tributaries and poor water quality of the mainstem Klamath River. Winter rearing habitat is severely lacking because of channel simplification, disconnection from the floodplain, degraded riparian conditions, poor large wood availability, and an estuary which has been altered and reduced in size due to development, channelization, and diking. Large wood has been removed and is not naturally replacing at the rates required to maintain key components of habitat complexity. Altered sediment supply in many tributaries has hindered fish passage, resulted in poor summer survival, poor spawning and incubation habitat suitability, and the loss and degradation of stream and off-channel habitat. Most potential spawning reaches have excessively embedded and armored substrate, making redd construction more challenging for adults and reducing permeability in constructed redds. Agricultural practices, channelization and diking, roads, and timber harvest are the biggest threats to this population.

2.4.4 Factors Affecting SONCC coho salmon Population Units and Critical Habitat in the Action Area.

There are a variety of factors affecting SONCC coho salmon in the action area, most of which have a negative effect on SONCC coho salmon and their critical habitat. The California drought, combined with the warm water "Blob" in the northeast Pacific Ocean had a toll on SONCC coho salmon in the action area, contributing to low returns of adult coho salmon. Limited and poor quality freshwater habitat, disease, and lack of forage in the ocean environment for multiple years in a row appears to have pushed adult returns to their lowest levels throughout the region. Restoration activities in the Trinity River basin and the lower Klamath River will likely benefit coho salmon populations by reducing several stressors in the action area like sedimentation or loss of LWD.

Effects from timber harvest including sedimentation, riparian habitat loss, reduced LWD recruitment, and water temperature impacts, are expected to continue through the action period. Impacts from roads are expected to remain similar or slightly decrease throughout the Proposed Action as more roads are decommissioned. Road decommissioning and culvert replacement will

help to reduce sedimentation in the future. Boutique wineries, organic farms, and residential development exacerbate late summer and fall water shortages, which impacts summer rearing areas for coho salmon. Marijuana cultivation and associated water utilization and unchecked grading and deforestation poses a significant threat to coho salmon in some locales, such as areas on the South Fork Trinity River. Residential growth in the Trinity basin and Lower Klamath River is expected to continue at a moderate pace, and its effects are negative due to increasing runoff and water use.

Climate Change Impacts in the Trinity Basin

According to models by the International Panel on Climate Change (IPCC 2019), 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 SONCC coho; 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 SONCC coho provides region-specific recovery actions that were identified by NMFS in order to facilitate recovery of this species (NMFS 2014). Implementation of some of these actions has already begun and more are in the planning phase.

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 all life stages of SONCC coho during proposed work. Adult coho salmon spawning and migration, juvenile migration, and juvenile rearing are likely to be affected by the proposed action. In-water project activities will occur during the summer low flow period (June 15 – October 15, or the first rainfall), after the majority of smolts have left the watershed but before most adults return. Restoration activities that may adversely affect SONCC coho or their designated critical habitat include stream dewatering, fish relocation, bank stabilization, heavy equipment operating in the channel, and increased mobilization of sediment. Monitoring and research activities that may affect fish include rotary screw traps that are proposed to run year round, tagging and holding studies, capture at existing weirs, hook-and-line surveys, beach seine activity, fyke netting, minnow trapping, and electrofishing. Young of the year (YOY) and age 1+ coho salmon are life stages that are most likely to be present. Adult coho salmon may be present during activities, but they will be able to physically avoid the effects of restoration work.

While implementation of the TRRP will have some negative influence on habitat and individuals, the program is expected to have an overall long term positive effect on salmonid habitat in the action area. Current projections of improved habitat quantity and quality potentially achievable by the TRRP range up to 107% to 112% increases for steelhead and Chinook salmon rearing capacities, respectively (Beechie et al. 2014). An estimate for potential improvement of coho salmon rearing capacity, though not specifically provided by Beechie et al. (2014), is assumed to be similar to the range for Chinook salmon and steelhead, based on the observations reported by Goodman et al. (2014) and Alvarez et al. (2015) that habitat preferences of juvenile coho salmon in the mainstem Trinity River are similar to Chinook salmon.

2.5.2 Negligible and Improbable Adverse Effects

This section focuses on only the project activities and their consequences that are expected to have negligible or improbable adverse effects to coho salmon and its critical habitat as explained further below.

2.5.2.1 Gravel Augmentation During High Flow Release

Impacts to juvenile coho could occur during augmentation of coarse sediment. Heavy equipment will work from the streambank and gravel dumping could disturb juvenile salmon, entomb, or crush them. However, the probability of injury is low because gravel augmentation sites during channel maintenance flows are high velocity areas that do not contain shallow vegetated habitat, preferred by salmon fry during the winter and early spring, when gravel addition is scheduled to occur. Gravel augmentation sites, both mid-channel and streambank sites, exhibit deeper channel cross-sections, with steeper banks and higher water velocities, than that preferred by juvenile salmon for rearing or adult coho salmon for spawning.

Stranding of coho salmon fry is possible on restored floodplain surfaces and side channels after construction. Although some stranding of salmon fry occurs naturally on shallow floodplains during receding flood flows (Sommer 2001), the constructed floodplain may contain residual features (e.g., equipment tracks, tilling rills) that could exacerbate this occurrence slightly. However, the floodplain, alcove, and side-channel surface designs incorporate a downstream slope similar to that of the river channel. Most features drain in a downstream direction toward the river channel guided by earthwork contours to minimize the potential for fish stranding. The risk of disturbance, stranding, and direct injury from gravel augmentation is unlikely to occur to improbable.

Gravel augmentation taking place during high flow events, will be a period when sediment transport, scour, and turbidity levels are likely to be within the natural range of variation experienced by fish in the action area. The timing of gravel augmentation will not coincide with spawning or migration activity and washed alluvium injected at high flow will not occlude the permeability of redds constructed months later. Injected gravels are expected to increase invertebrate production and available spawning habitat, and is likely to only have negligible adverse effects to coho salmon critical habitat. Similarly, injection of fine alluvium in the sediment-starved reach below Lewiston Dam will not exceed natural conditions expected during high flow conditions and will enhance habitat quality and ecological function by replenishing a pronounced deficit of fines immediately downstream of the dam.

2.5.2.2 Pile Driving

Impact pile driving conducted in or near waterways can generate underwater sound pressure that has the potential to injure or kill fish (Caltrans 2015). Since only wooden timber piles will be used to construct and stabilize some SLJs, acoustic impacts are reduced compared with metal piles. An underwater acoustic impact zone for the behavioral effect threshold of > 150 dB (decibels) RMS (root mean square) can be expected within 100 feet of a 12-inch wood pile driven in the water, but this impact zone reduces to 20 feet or less from shore for wood piles driven on land in the vicinity of a waterbody (Caltrans 2015).

The cumulative acoustic threshold for physical injury to juvenile salmon fry and smolts (≥ 183 dB sound exposure level) can be exceeded within 30 to 60 feet of wooden piles if the number of strikes exceeds 750 per day and fish are confined to this area (Caltrans 2015). At no time would the peak acoustic acute immediate injury threshold (206 dB for a single strike) occur during driving of wooden piles and fish will be free to exit the immediate area.

A small number of juvenile coho salmon may therefore be exposed to underwater sound levels (150-183 dB) that could cause a behavioral response such as startle or disorientation during the initial phases of pile driving but not physical injury. Fish would likely flee the area of disturbance upon initial pile strikes and relocate to other suitable habitat before the number of strikes and sound levels accumulated to a level that can cause physical harm (≥ 183 dB). There would be no restrictions on juvenile or adult salmon moving out of the acoustic impact zones because fish passage in the main river channel would not be impaired at any of the work sites. Though physical passage will be available at all times, individuals may be disturbed and

temporarily unable to pass the site or occupy potential rearing habitat. This will only be the case for a few hours at a time over a period of no more than one week until pile driving is completed. Any turbidity generated from pile driving is expected to be short-lived and not in sufficient amounts to interfere with feeding or other behaviors. For these reasons, possible effects to SONCC coho salmon and its critical habitat from pile driving is expected to be negligible and limited to minor disturbance.

2.5.2.3 Chemical Contamination

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. 2006). Due to emergency spill control measures and other BMPs, spills into salmonid waterways or releases larger than a few ounces from project activities are unlikely to occur. Any minor release of PAH will be quickly diluted even at low flow and exist in a measurable amount in critical habitat for only a few moments. Any fish in the immediate vicinity would experience temporary and minor irritation at most, or would disperse from the affected area. For these reasons, effects to individuals and critical habitat from PAHs and other chemical contamination are expected to be inconsequential.

2.5.2.4 Activities Taking Place in Dry Conditions

Certain activities, including road maintenance, a subset of fine sediment control measures, and stage zero channel restoration will take place under dry conditions and are consequently expected to have little adverse impact on fish or habitat. As stated earlier, road maintenance activities will include only work that would result in negligible effects on coho salmon habitat (e.g., working in dry conditions). Fine sediment control activities, other than the dredging of Hamilton Ponds, will take place far from aquatic habitat and/or follow all applicable conservation measures to minimize the risk of fine sediment introduction to the channel. Stage 0 restoration, such as at Indian and Salt creeks, will take place in the absence of flow as these channel go subsurface in the dry season. A surge of mobilized sediment may occur when flow returns to these channels in the winter or spring, but the increase in turbidity is expected to be short lived and minimal with BMPs. The small amount of sediment temporarily mobilized is not expected to persist long enough to cause significant irritation to fish or redistribute in a way that would compromise invertebrate or spawning habitat. Upslope activities are expected to be entirely beneficial in that they will arrest introduction of fine sediment to the channel in the long term and restore habitat access with little immediate risk of sediment mobilization to aquatic habitat. Possible effects to SONCC coho salmon habitat and individuals from activities occurring in the dry is therefore expected to be negligible.

2.5.2.5 In-stream Flow Restoration from Diversions

Implementing water conservation measures will benefit listed salmonids by maintaining or increasing instream flow such that rearing and migration conditions are improved. Increasing instream flow levels by reducing withdrawals and increasing use efficiency will enhance juvenile salmonid access to suitable rearing habitat, especially during the summer and early fall when flows are lowest. Installing water monitoring devices will likely result in discountable effects to listed species because they are nonintrusive, do not hinder salmonid behavior, and installation does not involve significant manipulation of the channel or riparian zone. Installation of rainwater collection devices and associated storage, forbearance, and other water conservation measures that improve water flow in streams will largely have beneficial effects. For the preceding reasons, any adverse effects to listed species and their critical habitat are expected to be negligible.

2.5.2.6 Temporary Reduction in Forage and Habitat from Riparian Vegetation Removal and In-Channel Heavy Equipment Use

Dewatering, heavy equipment use in the channel, and removal of riparian vegetation to access sites, grade floodplain areas, and re-contour banks will likely result in a temporary reduction of available forage and instream habitat. Invertebrates within the channel will be directly crushed or desiccated by construction activities. TRRP channel rehabilitation designs generally preserve large riparian trees or reuse them to create instream large wood structure but occasional removal of riparian tree canopy could result in temporary reduction of cover and shading, reduced nutrient cycling, and reduced terrestrial invertebrate production on a localized and temporary scale. Displacement of salmonids from preferred habitat may also result in an increased predation risk or reduced feeding efficiency through the loss of cover (Michney and Hampton 1984; Michney and Deibel 1986).

These effects are expected to negligible and temporary to both coho salmon and PBFs of critical habitat. Invertebrates will rapidly recolonize disturbed areas following reintroduction of water (Harvey and White 2008). No net loss of riparian vegetation will occur and plantings will immediately ameliorate loss of riparian function. Addition of LWD structures will provide cover and shade adjacent to pools and encourage natural sediment build up next to the wood structures, allowing the bank to fill in and recruit more vegetation for long-term streambank functions and development of habitat features. Increases in shallow water habitats at point bars and along floodplains, including side channels and alcoves, will benefit invertebrate production and increases in point bar surface areas will increase salmon spawning habitat within the boundaries of the rehabilitation sites (Goodman et al. 2012; Beechie et al. 2014). Project activities will ultimately increase floodplain connectivity, reactivate channel migration across floodplains, and improve riparian and aquatic habitat diversity for anadromous salmonids throughout the action area.

2.5.2.7 Noise, Motion, and Vibration Disturbance from Heavy Equipment Operation and Bedrock Fracturing

Heavy equipment operation within or near the channel 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. Brown trout were introduced as a game fish to the Trinity River watershed by CDFW and are known to prey on juvenile salmonids including coho salmon (Alvarez 2014). Some adult and juvenile coho salmon may experience up to four consecutive hours of migration delay at a given site due to work activity during a normal work day (under the assumption that workers will take a lunch break at midday and refueling may also interrupt heavy equipment operation), although activities are timed to avoid the bulk of adult and smolt migrants.

Adult coho salmon 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 coho salmon resulting from heavy equipment activity is expected to be short-term, lasting no more than 4 consecutive hours per day.

Bedrock fracturing within the active river channel conducted with jackhammers or expanding grout will take place in an enclosure coffered with barriers (the adverse effects of dewatering are discussed under section 2.5.3.1).

Coho salmon 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 multiple sites. Heavy equipment can generate noise sufficient to produce a startle response and evasive behavior in salmonids (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 as the number of projects per year involving heavy equipment in the water is limited, passage will be maintained at all sites throughout construction, and noise will be discontinuous throughout the day and cease at night when most fish are migrating (Moyle 2002). Because of the proposed BMPs, 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.

2.5.2.8 Direct Observation Snorkel and Redd Surveys

Coho salmon will be observed in-water (e.g., by snorkel surveys or from the banks or boats) as part of some research and monitoring projects. Direct observation is the least disruptive method for determining a species' presence/absence and estimating their relative numbers. Its effects are also generally the shortest-lived and least harmful of the research activities discussed in this section because a cautious observer can effectively obtain data while only slightly disrupting the fishes' behavior.

Juveniles frightened by the turbulence and sound created by observers are likely to seek temporary refuge in deeper water or physical cover. In extreme cases, some individuals may leave a particular habitat type and then return when observers leave the area. Monitoring or research also involves observing adult fish, which are more sensitive to disturbance. During some of the monitoring or research activities discussed below, redds may be visually inspected, but, would not be stepped on (Reclamation 2019). Disturbance to coho salmon individuals is primarily associated with these observation activities, and no injuries or deaths are expected to occur. Because these effects are so small, there is little a surveyor or researcher can do to mitigate them except to avoid disturbing sediments, gravels, and, to the extent possible, the fish themselves, and allow any disturbed fish the time they need to reach cover. Therefore, the effect of disturbance from snorkeling and red surveys is expected to be negligible.

2.5.2.9 Crowding and Predation at Relocation Sites

In some instances, relocated fish may endure short-term stress from crowding and competition at relocation sites. Displacement may also temporarily expose juvenile fish to a greater risk of predation and reduce foraging success. As stated earlier, piscivorous brown trout have been introduced to the Trinity River and are known to prey on juvenile salmonids (Alvarez 2014). However, most relocated fish will likely choose not to remain in the relocation sites and will seek lower density areas. The effects of competition are expected to quickly diminish as fish disperse. In addition, the number of fish affected by increased competition at relocation release sites is not expected to be significant based upon the anticipated low number of coho salmon likely to inhabit any one channel rehabilitation site. Juvenile rearing habitat in the mainstem Trinity River is not likely to be limiting for coho salmon during summer and fall months (NMFS 2006) when work will take place. Rearing habitat 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. Therefore, the effect of potentially increased competition and predation after fish relocation is expected to be negligible.

2.5.2.10 Temporary Stream Crossings

Temporary channel crossings in the mainstem are proposed between July 15 and October 15. Young of the year coho salmon typically reside in pools or deeper habitat where temporary stream crossings are not constructed. Yearling coho salmon would likely avoid exposure because equipment will operate after their outmigration period. Also, juvenile coho salmon and adult

listed salmonids will be of sufficient size and maturity to successfully flee and avoid death or injury from temporary stream crossing installation and removal. Therefore, no juvenile or adult coho salmon are expected to be crushed, buried, or otherwise injured by equipment associated with temporary stream crossing installation and removal.

2.5.3 Adverse Effects to Species

2.5.3.1 Dewatering and Fish Relocation

Dewatering and fish relocation will be necessary for a number of proposed projects including, instream channel construction, bank stabilization, bedrock fracturing, barrier removal, and culvert replacement. This work will take place during seasonally low flow, and juvenile coho salmon are likely to be exposed to potential adverse effects. Adults are physically able to avoid work activity and are not expected to be present during fish removal, but in the unlikely event that adults are found in the work area, they will be safely removed via herding. Fish salvage is not required at all of the channel rehabilitation sites, approximately 50% of the total remaining channel rehabilitation sites would require fish salvage efforts in the future and that no more than four channel rehabilitation sites per year would be implemented in the mainstem Trinity River (Reclamation 2019). Juvenile coho salmon numbers are expected to be low as similar efforts in the past have encountered two or less coho salmon with most sites producing large numbers of steelhead and Chinook salmon (Reclamation 2019).

Dip nets have been successfully employed for collection in the past with small numbers of coho salmon (Reclamation 2019), but fish relocation may include use 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 (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. Referencing results from similar restoration and fish salvage efforts in Northwestern California (CDFW 2013, 2014, 2015, 2016, 2017, 2018; NOAA RC 2012, 2018, 2019, 2020), we expect that under typical water temperature conditions along the upper Trinity River, no more than 2 percent mortality of captured fish at each fish relocation site would occur.

2.5.3.2 Desiccation or Mechanical Crushing During Relocation, Channel Construction, Stream Crossings, and Low Flow Gravel Augmentation

Any fish not recovered during salvage operations would be subject to desiccation or mechanical injury. Coho salmon may be injured by contact with construction equipment operating in the channel but numerous measures will be employed to reduce this probability. In-channel

construction activities will be conducted only during the summer-to-early fall, low-flow conditions (June 15 – October 15), avoiding the potential for direct effects on spawning coho salmon and alevins, since this period is outside the adult migration and spawning and egg incubation season in the action area (Shaw et al. 1997). The in-river work window also corresponds to the season when the fewest number of juvenile coho salmon are known to occur in the action area, after age-0 pre-smolt emigration, but before active yearling smolt migration (Glase 1994 and Petros et al. 2015). Pre-construction surveys will identify and avoid potential injury to collections of juvenile or adult fish. Heavy equipment will also operate in a slow, deliberate manner allowing fish to avoid contact with equipment in an open channel. Seining will be employed at some sites, including Hamilton Ponds, to herd fish out of the site before exclusionary turbidity curtains are placed, preventing reentry of juvenile fish into the work area.

The USFS et al. (2013) reported capture efficiency for similar salvage operations and, based on this related experience, we expect that up to five percent of juvenile coho salmon may not be removed from fish herding or salvage and be left behind to suffer mortality from desiccation or direct mechanical crushing. If we assume 95% of fish are captured, then up to 5% of coho salmon juveniles originally located within dewatered areas may be left behind and killed by crushing or desiccation.

Some gravel augmentation sites will be located in low velocity, shallow, backwater areas that may be occupied by juvenile coho salmon. Gravel injection sites during low flow will be seined prior to gravel placement, but some fish may avoid displacement by seines or burrow into gravel and potentially be crushed by rock placement. We expect mortality to juvenile coho salmon from shallow water gravel augmentation to be similar to mechanical crushing, which is up to five percent of the juvenile coho salmon initially present at those sites.

2.5.3.3 Increased Suspended Sediment Concentrations

Multiple activities under the proposed action have the potential to increase sediment mobilization including in-channel construction, barrier removal, dredging, heavy equipment use, gravel injection at low flow, and floodplain grading. 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 suspended sediment, which contributes to 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 sediment mobilization by restoration activities, but several factors will reduce the potential impact of suspended sediment. Erosion and turbidity BMPs will be maintained to ensure compliance with the turbidity thresholds of the TRRP's or participating agency's Section 401 water quality certification (e.g., >20 NTU at 500 feet downstream of in-river construction when background turbidity is ≤20 NTU; and > 20 percent increase in turbidity

at 500 feet downstream when background is > 20 NTU). If standards are not met, construction activities will cease. Dredging of fine sediment from Hamilton Ponds will increase turbidity of water in the immediate area of the ponds; however, use of silt control curtains to isolate the work area and bypass of Grass Valley Creek flows around the sediment retention ponds during dredging will minimize any increase in turbidity of the Trinity River to allowable levels.

However, the onset of higher flows in the spring are expected to produce erosion and sustained turbidity levels in excess of accepted standards for up to seven days in mainstem projects (Gutermuth 2020). Following construction when flows initially rise, fish within 500 feet downstream of the site may experience adverse effects. Fish will have unrestrained opportunity to physically avoid intense turbidity, but we will assume that some juvenile coho salmon will not vacate these reaches and will thus be exposed to turbidity levels capable of causing stress and decreased feeding for up to 7 days while the turbidity plume persists. These effects are not expected to significantly change the growth or fitness of any fish. Sustained turbidity generated from the proposed instream restoration projects will likely cause temporary, physiological and behavioral effects, such as dispersing salmonids from established territories, and potentially increasing interspecific and intraspecific competition, as well as temporarily increasing predation risk for a small number of affected juveniles. Since the number of fish cannot be reliably observed or calculated, NMFS will use the maximum number of consecutive days (seven) observed by Gutermuth (2020) and maximum TRRP observation of 75 NTUs above background (Gutermuth 2020) expected to exceed turbidity standards at each individual channel reconstruction site as a metric for adverse effects to coho salmon. Based on these observations, turbidity is not expected to exceed 75 NTUs above background levels at any site following channel rehabilitation or shallow water gravel augmentation as measured 500 feet downstream of construction activity during instream work and within 7 days of rewatering the restored channel.

2.5.3.4 Bank Stabilization

The long-term impacts from channelization likely portend a long-term continuation of impaired juvenile coho salmon abundance at the bank stabilization sites over successive generations, relative to what would be expected under natural stream conditions and channel function. The dynamic through which these effects occur is reasonably straightforward. Some individual fish likely grow slower due to less food supplied by the channelized stream, as compared to a natural stream bank. If these smaller fish are unable to move to areas with better resources for growth, they likely experience lower survival upon ocean entry (Holtby et al. 1990), especially if unfavorable ocean conditions exist. As a result, these smaller fish are less likely to return and spawn.

However, the proposed bio-engineered approach (e.g., riparian planting and instream wood placement that create natural cover elements) will improve habitat condition relative to what currently exists within the channelized action area (Zika and Peter 2002). We expect substantially more juvenile fish will be able to successfully rear in these areas after bio-engineering bank stabilization improves habitat conditions. Successful rearing includes a likelihood of returning to spawn relatively similar to fish rearing in other areas of the watersheds where these bank stabilization projects occur. This improvement does not fully counter-balance

the ongoing impact on habitat function and future juvenile population growth caused by extending channelization into the foreseeable future, but instead compensates for it to a fair degree at the site level. Translating this remaining impact into actual injury/death at the individual fish level, is inherently difficult, given the indeterminate nature of future programmatic actions (e.g., project location, project technique, current onsite habitat quality, current population dynamics of impacted fish, etc.), necessitating the use of a habitat-based proxy.

The habitat proxy we chose to estimate the extent of fish loss is the length of bio-engineered streambank restored per project (streambank length must be less than 3x the active channel width), and the number of projects implemented per year (3). Because these sites are very small relative to the stream area available to rearing juveniles throughout the action area, and because of the compensation noted above, NMFS expects overall reductions in juvenile fish numbers to be minimal.

2.5.3.5 Collection for Monitoring and Research

Various monitoring and research projects will involve fish capture, handling, tissue sampling, fin clipping, and tagging. Fish may be injured or killed when exposed to electrofishing, beach seins, fyke nets, screw traps, tagging, clipping and/or tissue sampling. TRRP has closely monitored these activities in the past and found that actual take and mortality numbers for research conducted in 2016 and 2017 were considerably lower than authorized take and mortality for implemented activities. Researchers were permitted to handle a total of 16,520 fish while only 607 and 456 fish were handled in 2016 and 2017, respectively (electrofishing, angler surveys, and snorkeling were not conducted in 2017). Reported mortality from all research and monitoring activities was 7 juveniles in 2016 and 8 in 2017 (Reclamation 2019); however, these mortality numbers likely do not include predation, which is difficult to count. Expected mortality and number of fish handled by activity is listed in the following sections. Overall, a total of 20,310 fish may be handled and mortality is not expected to exceed 734 individuals annually (3.6%), as described below. Actual annual capture and mortality numbers are likely to be significantly lower than the maximums.

These techniques are minimally intrusive in terms of their effect on habitat because they would involve very little, if any, disturbance of streambeds or adjacent riparian zones. None of the activities will measurably affect any habitat PBFs. Moreover, the proposed activities are all of short duration. Therefore, the proposed monitoring and research are expected to have negligible impacts on any designated critical habitat. The following subsections detail effects of each proposed monitoring/research activity.

Trapping

Rotary screw traps, fyke traps, minnow traps, and beach seines will be used to collect fish. Based on years of sampling at hundreds of locations under hundreds of scientific research authorizations (NMFS 2015b), we would expect the mortality rates for fish captured at rotary screw type traps to be one percent or less of captured fish. The trapping, capturing, or collecting

and handling of juvenile fish using traps is likely to cause some stress on listed fish. However, fish typically recover rapidly from handling procedures. The primary factors that contribute to stress and mortality from handling are excessive doses of anesthetic, differences in water temperature, dissolved oxygen conditions, the amount of time that fish are held out of water, and physical trauma. Stress on salmonids increases rapidly from handling if the water temperature exceeds 64.4° Fahrenheit (18° Celsius) or if dissolved oxygen is below saturation. Additionally, stress can occur if there are more than a few degrees difference in water temperature between the stream/river and the holding tank. Fish that are transferred to holding tanks can experience trauma if care is not taken in the transfer process, and fish can experience stress and injury from overcrowding in traps that are not emptied on a regular basis. Debris buildup in traps can also kill or injure fish if the traps are not monitored and cleared on a regular basis. In addition, predation of salmonid fry in the trap can range from less than 1 percent to more than 10 percent in any given year (Duffy et al. 2011).

Between 1999 and 2001, Duffy et al. (2011) found that predation on coho salmon averaged 1.28 percent of the total captured coho salmon (i.e., including coho salmon recovered in predators' stomachs) in migrant traps set in Prairie Creek, a tributary of Redwood Creek, CA. The highest annual predation on coho salmon in the trap was 3.2 percent of the total captured coho salmon (i.e., including coho salmon recovered in predators' stomachs; Duffy et al. 2011). The fork lengths of the eaten coho salmon were almost all 55 mm or less (Duffy et al. 2011). This indicates that young of the year are most at risk from predation, while yearlings and smolts are generally not eaten in traps. Aside from predation, coho salmon mortality associated with downstream migrant trapping on the Trinity River have been approximately up to 1.8% (7 juvenile coho salmon died out of 593 handled in 2016 and 8 juvenile coho salmon of 450 handled in 2017 (Reclamation 2019).

However, the potential for unexpected injuries or mortalities among listed fish is reduced in a number of ways. In general, traps are checked at least daily and usually fish are handled in the morning. This ensures that the water temperature is at its daily minimum when fish are handled. Also, fish may not be handled if the water temperature exceeds 70° Fahrenheit (21° Celsius). Great care must be taken when transferring fish from the trap to holding areas and the most benign methods available are used—often this means using sanctuary nets when transferring fish to holding containers to avoid potential injuries. Captured fish must be allowed to fully recover before being released back into the stream and will be released only in slow water areas.

Tagging/Marking

All sampling, handling, and tagging procedures have an inherent potential to stress, injure, or even kill the marked fish. PIT tags are inserted into the body cavity of fish just in front of the pelvic girdle. The tagging procedure requires capturing and handling of fish; therefore any researchers engaged in such activities will follow the conditions listed previously (as well as any permit-specific conditions) to ensure that the operations take place in the safest possible manner (NMFS 2015b). In general, the tagging operations will take place where there is cold water of high quality, a carefully controlled environment for administering anesthesia, sanitary conditions, quality control checking, and a carefully regulated holding environment where the

fish can be allowed to recover from the operation. PIT tags have very little effect on growth, mortality, or behavior. The few reported studies on PIT tagging have shown no or little effect on growth or survival (Tiffan et al. 2015 and Achord et al. 2012).

Other methods for tagging fish include acoustic tags, radio tags, or archival loggers. There are two main ways to accomplish this and they differ in both their characteristics and consequences. First, a tag can be inserted into a fish's stomach by pushing it past the esophagus with a plunger. Stomach insertion does not cause a wound and does not interfere with swimming. This technique is benign when salmon are in the portion of their spawning migrations during which they do not feed (Nielsen 1992). In addition, for short-term studies, stomach tags allow faster post-tagging recovery and interfere less with normal behavior than do tags attached in other ways.

The second method for implanting tags is to place them in the body cavities of (usually juvenile) salmonids. These tags do not interfere with feeding or movement. However, the tagging procedure is difficult, requiring considerable experience and care (Nielsen 1992). Because the tag is placed in the body cavity, it is possible to injure a fish's internal organs. Infections of the sutured incision and the body cavity itself are also possible, especially if the tag and incision are not treated with antibiotics (Chisholm and Hubert 1985, Mellas and Haynes 1985).

Fish with internal tags often die at higher rates than fish tagged by other means because tagging is a complicated and stressful process. Mortality is both acute (occurring during or soon after tagging) and delayed (occurring long after the fish have been released into the environment). Acute mortality is caused by trauma induced during capture, tagging, and release. It can be reduced by handling fish as gently as possible. Delayed mortality occurs if the tag or the tagging procedure harms the animal in direct or subtle ways. Tags may cause wounds that do not heal properly, may make swimming more difficult, or may make tagged animals more vulnerable to predation (Howe and Hoyt 1982, Matthews and Reavis 1990, Moring 1990). Tagging may also reduce fish growth by increasing the energetic costs of swimming and maintaining balance. Up to 5,500 juvenile coho salmon are proposed to be handled for PIT tagging and mortality is not expected to exceed 1% of tagged coho salmon (e.g., up to 55 individuals) annually.

Tissue Sampling

Tissue sampling techniques such as fin-clipping are common to many scientific research efforts using listed species. All sampling, handling, and clipping procedures have an inherent potential to stress, injure, or even kill the fish. Fin clipping is the process of removing part of a fin to obtain non-lethal tissue samples. Many studies find that fin clips do not generally alter fish growth. Studies comparing the growth of clipped and unclipped fish generally have shown no differences between them (Brynildson and Brynildson 1967). Moreover, wounds caused by fin clipping usually heal quickly, especially those caused by partial clips.

Mortality among fin-clipped fish is variable. Some immediate mortality may occur during the marking process, especially if fish have been handled extensively for other purposes (e.g., stomach sampling). Delayed mortality depends, at least in part, on fish size; small fishes have often been found to be susceptible to it and Coble (1967) suggested that fish shorter than 90

millimeters are at particular risk. The degree of mortality among individual fishes also depends on which fin is clipped. Studies show that adipose- and pelvic-fin-clipped coho salmon fingerlings have a 100 percent recovery rate (Stolte 1973). Recovery rates are generally recognized as being higher for adipose- and pelvic-fin-clipped fish in comparison to those that are clipped on the pectoral, dorsal, and anal fins (Nicola and Cordone 1973). Clipping the adipose and pelvic fins probably kills fewer fish because these fins are not as important as other fins for movement or balance (McNeil and Crossman 1979). Tissue samples from up to 3,500 coho salmon is proposed to be removed annually and only one mortality or 0.03% of the total captured is expected.

Electrofishing

Electrofishing can cause a suite of effects ranging from disturbance to mortality. The amount of unintentional mortality attributable to electrofishing varies widely depending on the equipment used, the settings on the equipment, and the expertise of the technician. Most studies on the effects of electrofishing on fish have been conducted on adult fish greater than 300 millimeters in length (Dalbey et al. 1996). The relatively few studies that have been conducted on juvenile salmonids indicate that spinal injury rates are substantially lower than they are for large fish. Smaller fish are subjected to a lower voltage gradient than larger fish (Sharber and Carothers 1988) and may, therefore, be subject to lower injury rates (Thompson et al. 1997). The incidence and severity of electrofishing damage is partly related to the type of equipment used and the waveform produced (Dwyer and White 1997). Continuous direct current (DC) or low-frequency (30 hertz) pulsed DC have been recommended for electrofishing (Dalbey et al. 1996) because lower spinal injury rates, particularly in salmonids, occur with these waveforms (Sharber et al. 1994, Dalbey et al. 1996). Only a few recent studies have examined the long-term effects of electrofishing on salmonid survival and growth (Dalbey et al. 1996, Ainslie et al. 1998). These studies indicate that although some of the fish suffer spinal injury, few die as a result. However, severely injured fish grow at slower rates and sometimes they show no growth at all (Dalbey et al. 1996).

Conservation measures (Reclamation 2019) require that all researchers follow NMFS' electrofishing guidelines (NMFS 2000). In all cases, electrofishing is used only when other survey methods are not feasible. Researchers and monitors will handle listed fish with extreme care and keep them in cold water to the maximum extent possible during processing. When fish are transferred or held, a healthy environment must be provided. Captured fish that are anesthetized will be allowed to recover before release. The capture and handling of listed fish will cease if the water temperature exceeds 70 degrees Fahrenheit at the capture site. Under these conditions, listed fish may only be identified and counted. Electrofishing is not permitted if water temperatures exceed 64 degrees Fahrenheit.

Conservation measures (Reclamation 2019) prohibit the researcher from intentionally targeting adult listed fish and the researcher must stop electrofishing if they encounter an adult listed fish. An annual total of 500 juvenile coho salmon may be electroshocked (Reclamation 2019) and mortality may not exceed 3 percent of electroshocked coho salmon (up to 15 individuals yearly

for electrofishing) based on mortality data from monitoring reports (Collins 2004, NOAA RC 2012).

Angling

Angling studies target non-native species but take place year round and unintentional bycatch of SONCC coho salmon may occur. Fish that are caught and released alive as part of a monitoring or research project may still die as a result of injuries or stress they experience during capture and handling. The likelihood of killing a fish varies widely, based on a number of factors including the gear type used, the species, the water conditions, and the care with which the fish is released. Some investigators believe that the use of barbless hooks reduces handling time and stress on hooked fish and adds to survival after release (Wydoski 1977). Fish hooked in the jaw or tongue suffered lower mortality (2.3 and 17.8 percent in Lindsay et al. 2004) compared to fish hooked in the gills or esophagus (81.6 and 67.3 percent). A large portion of the mortality in the Lindsay et al. (2004) study was related to deep hooking by anglers using prawns or sand shrimp for bait on two-hook terminal tackle. Other baits and lures produced higher rates of jaw hooking than shrimp, and therefore produced lower hooking mortality estimates. In summary, catch-and-release mortality of juvenile salmonids is generally less than 10 percent and approaches 0 percent when researchers are restricted to use of artificial flies and lures (NMFS 2015b). Annually, up to ten coho salmon juveniles may be caught and zero mortalities are expected.

2.5.4 Adverse Effects to Critical Habitat

2.5.4.1 Bank Stabilization

Bank stabilization measures to minimize bank erosion may be implemented at channel rehabilitation sites or at other locations (such as private property). Bioengineered bank stabilization techniques and mitigation measures (e.g., wood placement and vegetation) that enhance or create salmonid habitat are incorporated into the designs are outlined in the BA (Reclamation 2019). Some of these projects may require excavation and placement of large rock at the toe of the slope, below the OHWM and possibly in the active channel. Although work will take place during low flow, some projects may need to incorporate isolation from flowing water and fish salvage. Effects of isolation and salvage are described in the preceding section, but bank stabilization has potential effects on habitat as well.

Bank stabilization will protect property by impeding further lateral migration of the channel, which can be a critical process for creating habitat conditions on which salmonids depend. Lateral migration is important for producing undercut banks and side channels and recruiting gravel and woody debris to the channel (Spence et al. 1996). These are habitat features that increase both quantity and quality of habitat, which are necessary to increase the number of juvenile coho salmon that the action area can support. Bank protection generally prevents the channel from lengthening, leading to a relative increase in bed slope and reduction in bed and bank area. The result is often increased stream energy expressed as erosion downstream from the armoring and/or channel incision at the armoring, sometimes extending upstream and/or downstream. Increased stream energy and competency can alter particle size distribution in the

channel. In addition to destabilizing other portions of the bank and bed, bank protection prevents the channel from creating additional salmonid habitat in the immediate vicinity of the armoring through normal riverine processes (Schmetterling et al. 2001). In summary, bank protection typically reduces both habitat quantity and habitat quality for salmonids over the long term, which eventually reduces the number of fish that the action area can support.

However, the Trinity River is, in large part, confined within a narrow canyon and channel migration, while important for creation of salmonid habitat, may not play as significant a role in this particular system relative to other habitat forming processes. Habitat benefits of bank stabilization will include stabilizing erosion-prone areas, reducing fine sediment input to streams, and providing LWD cover in wood-poor streams. Bioengineered projects will also likely increase riparian vegetation and associated benefits locally. Unlike the common, favored approach of lining the entire streambank with rock rip rap that results in a habitat interface lacking suitable juvenile fish habitat (Schmetterling et al. 2001), the proposed bio-engineering methods will instead use natural material (e.g., live plantings, logs and rootwads, boulders) to craft a streambank that will resist lateral erosion while providing complex rearing, feeding and sheltering habitat.

2.5.4.2 Increased Sediment Mobilization

In-channel construction activities will occur during low-flow conditions between July 15 and October 15, minimizing the potential for adverse effects on coho salmon spawning and egg incubation. Additionally, we anticipate that all project-related sediment will be flushed out during initial high flows after each project is completed, and site restoration measures are expected to minimize future project-related sediment inputs to stream channels. Some fine sediment may settle near or on known spawning habitats located downstream of riverine rehabilitation areas, but this deposition is not expected to be significant enough to impair spawning, incubation success, or impact invertebrate production to a meaningful level. Sediment and turbidity plumes will be most concentrated in the immediate vicinity of tributary projects and typically dissipate within 24 hours, based on TRRP monitoring of past restoration projects (TRRP 2011a, b; 2012a, b; 2013). Therefore, these turbidity impacts are not expected to appreciably or permanently alter the ability of the habitat to support the PBFs of critical habitat given the short duration and limited distance of elevated turbidity expected.

2.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02 and 402.17(a)). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

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, only the Iron Gate Hatchery's (IGH) Chinook salmon program is a future non-Federal action. Though IGH is not in the action area, it produces Chinook salmon that migrate and rear in the lower Klamath River. Because of the spatial distance of IGH and the lower Klamath River, IGH Chinook salmon are expected to adversely affect coho salmon in the action area through competition in the lower Klamath River until approximately eight years after the Klamath Dams are removed. 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. 2018). 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.

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. Presently, there is no landscape scale evaluation of the effects of cannabis farming in the SONCC coho salmon ESU or the effects to particular streams from multiple farms. NMFS expects that continued operation of cannabis farms throughout the ESU will continue to negatively impact SONCC coho salmon.

Residential Development

Human population growth in the action area is expected to remain relatively stable over the next 10 years as California's economy continues to recover from a long-lasting nationwide recession. The recession has had significant economic impacts at both the statewide and local scales with widespread impacts to residential development and resource industries such as timber and fisheries. However, some development will continue to occur which, on a small-scale, can impact coho salmon habitat. Once development and associated infrastructure (e.g., roads, drainage, and water development) are established, the impacts to aquatic species are expected to be permanent.

Anticipated impacts to aquatic resources include loss of riparian vegetation, changes to channel morphology and dynamics, altered hydrologic regimes (increased storm runoff), increased sediment loading, and elevated water temperatures where shade-providing canopy is removed.

The presence of structures and/or roads near waters may lead to the removal of LWD in order to protect those structures from flood impacts. The anticipated impacts to Pacific salmonids from continued residential development are expected to be sustained and locally intense. Commonly, there are also effects of home pesticide use and roadway runoff of automobile pollutants, introductions of invasive species to nearby streams and ponds, attraction of salmonid predators due to human occupation (e.g., raccoons), increased incidences of poaching, and loss of riparian habitat due to land clearing activities. All of these factors associated with residential development can have negative impacts on salmon populations. However, population growth rate in Trinity County decreased by about 11% between 2010 and 2019 (U.S. Census Bureau 2020). This may indicate a trend that could ameliorate or reduce the effects of residential development.

Resource Extraction

Resource-based industries are likely to continue to have an influence on environmental conditions within the action area for the indefinite future. Logging continues to be conducted primarily on private lands throughout the tributary watersheds of the Trinity River, except in Canyon Creek (Reclamation 2019). Some mining for gravel, aggregate, and minor precious metals occurs on the Trinity River floodplain and a few tributary watersheds. Mining operations can affect coarse sediment supplies and impair water quality via contaminated and sediment-laden runoff from operations. The lack of protective measures in existing regulatory mechanisms, including land management plans (e.g., State Forest Practice Rules), contribute in 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.

Control of wildland fires on non-federal lands

Control of wildland fires may include the removal or modification of vegetation due to the construction of firebreaks or setting of backfires to control the spread of fire. This removal of vegetation can trigger post-fire landslides as well as create chronic sediment erosion that can negatively affect coho salmon habitat. Also, the use of fire retardants may adversely affect salmonid habitat if used in a manner that does not sufficiently protect streams, causing the potential for coho salmon to be exposed to lethal amounts of the retardant. This exposure is most likely to affect summer rearing juvenile coho salmon. As wildfires are stochastic events, NMFS cannot determine the extent to which suitable coho salmon habitat may be removed or modified by these activities

2.7 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.5) to the environmental baseline (Section 2.4) and the

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

Cumulative effects will continue to degrade habitat quality for 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 SONCC coho salmon in various ways including the exacerbation of competition with hatchery produced fish. Resource extraction and residential development in upslope areas will further impact watershed function on a larger scale but activity within the 100-year floodplain will be limited. 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. The threat of misapplication of fire retardant is likely to increase with climate change driving larger and more frequent wildfire events.

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 status of SONCC coho salmon population units in the action area mirrors that of the ESU overall, with declining abundance apparent in the Willow Creek Weir counts and seemingly throughout all populations. The unprecedented drought (2012-2016), combined with poor ocean conditions over the same time period, reduced stream flows, reduced ocean forage, and increased ocean and stream temperatures, further exacerbating stress, disease, and decreasing the quantity and quality of spawning and rearing habitat available to population units in the action area. The new information since Williams et al. (2016) 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.

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 Trinity Basin. Although the Trinity River Division effectively removed an enormous amount of habitat, Trinity Reservoir may provide a buffer to mainstem Trinity River water temperatures in a warming climate because water can be drawn from the cold bottom layer of the reservoir (as long as reservoir levels are sufficient). 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 the temporary or minimal effects of noise and disturbance, water quality impairment (possible PAH or spills), temporary reduction in forage and habitat availability, and upslope procedures. Instream flow restoration through increased use efficiency and reduction of water withdrawals will enhance juvenile salmonid habitat, especially during periods of critical low-flow. Bank stabilization may have the potential to inhibit habitat forming processes. However, restoration activities conducted or funded by the TRRP and/or participating federal agencies are expected to be beneficial in the long run with reactivation or mimicking of natural habitat forming processes that will likely increase production of salmonids. While there will be some loss of habitat function and carrying capacity at the anticipated few areas where natural channel function still exists and critical infrastructure needs protection, we expect these losses to be small relative to the gains in habitat condition in more urbanized areas. Most of the bank stabilization work needed to protect critical infrastructure occurs in urban and urbanizing areas where such infrastructure is common and channelization has already occurred. In addition, the gains in urbanized areas are likely to further help offset any losses to juvenile salmonids occurring when juveniles are relocated from work areas. Thus, the proposed action does not appreciably reduce the likelihood of survival or recovery of SONCC coho salmon, nor does it appreciably degrade the value of its critical habitat.

The proposed action will have immediate and long-term improvements to current conditions for coho salmon in the action area. We anticipate that the TRRP's mainstem channel rehabilitation and sediment management, along with the ongoing TRRP fishery flow management regime, will increase floodplain connectivity, reactivate channel migration across floodplains, and improve riparian and aquatic habitat quality for anadromous salmonids throughout the action area. A bioengineered, dynamic fluvial channel is expected to create shallow water habitat that will benefit juvenile salmon rearing habitat and increase available spawning habitat (Goodman et al. 2012; Beechie et al. 2014). Addition of large wood, including SLJs, is expected to promote sorting and deposition of alluvium suitable for spawning and provide immediate physical habitat for rearing coho salmon. The addition of trees and wood creates desired geomorphic effects within reaches, promotes channel migration and avulsion, causes local bed mobilization and scour, retains coarse sediment and promotes island or medial bar formation, and provides a source of LWD for future recruitment to downstream reaches. As mentioned earlier, the collective actions of the TRRP and participating agencies are projected to substantially improve salmonid rearing capacity (Beechie 2014).

In summary, channel rehabilitation, fine sediment management, and watershed restoration activities will provide long-term benefits to water quality conditions for coho salmon in the mainstem and tributaries by improving and restoring channel structure and habitat complexity, floodplain connectivity, riparian vegetation structure and diversity, and by reducing excess accumulations of fine sediment in the river channel and sediment loads entering the river from tributaries. TRRP activities will promote conditions that:

- Reduce fine sediment loads from upslope sources and turbidity through improved sediment retention from increased channel and floodplain structural complexity.

- Improve nutrient input and retention by increasing riparian diversity through increased channel structural complexity and floodplain inundation.

- Maintain or reduce water temperatures by increasing vegetation shading and hyporheic flow.

Annual project limits are expected to prevent cumulative impacts to water quality (sediment, turbidity, and water temperatures) in the watershed. 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 proposed activities from dewatering and relocation, desiccation, crushing from heavy equipment use or shallow water gravel augmentation, increased turbidity, and handling required by various studies. However, a number of BMPs and conservation measures will reduce the number of coho salmon exposed to adverse effects. In-channel construction activities will be timed to avoid adult migration, spawning, and egg incubation and occur when the least number of juvenile coho salmon are in the action area. Pre-construction surveys will help to avoid injury to collections of fish and heavy equipment will also operate in a deliberate manner allowing fish to avoid mechanical injury. Herding, temporary blocking of the disturbance area, and any necessary fish relocation will reduce the number of fish that may be crushed. After herding and blocking access, the likely low number of fish present at restoration sites would be relocated, of which up to 2% may experience injury or mortality. We estimate that up to 5% of coho salmon juveniles originally located within dewatered areas may be left behind and killed by crushing or desiccation. Based on previous observations from TRRP personnel, fish may be exposed to elevated turbidity levels as a high as 75 NTUs above background, within 500 feet downstream of channel rehabilitation for as many as 7 consecutive days following channel reconstruction. Fish in the turbidity plume may experience adverse effects in the form of reduced feeding and physiological stress. However, these effects will be limited to a few individuals for a short period of time and will not be sufficient to significantly impact abundance at the population, stratum, or ESU levels.

Stream crossings will be constructed with sufficient depth, velocity, and large substrate to allow passage and discourage spawning. Construction will pause if turbidity thresholds are exceeded researchers will adhere to protocols, referred to earlier, designed to reduce handling and capture mortality. Mortality from monitoring and research activities that involve capture, handling, tissue

sampling, and PIT tagging are expected to be minimal with implementation of safe handling measures. Monitoring and research will provide fisheries managers the ability to administer and implement protocols designed to recover coho salmon to historic levels (Quinn et al. 2017) at an expected nominal cost to individual fish with low percentages of take. PIT tagging studies may reveal the relationship between flow release and outmigration timing by juvenile salmonids, and establish a causal link between outmigration timing and juvenile survival. As stated earlier, PIT tagging has been demonstrated to have minimal impacts on growth and survival. Various BMPs will also reduce stress on captured coho salmon. Effects to individual fish from gravel augmentation in deep water/ high velocity areas, pile driving, snorkel surveys, and crowding and predation at relocation sites are not expected to reach levels approximating take as explained in section 2.5.2.

Because injury and mortalities are limited by conservation measures and project sideboards, and the restoration program will likely result in increased quantity and quality of salmonid habitat, the effects of the proposed action are unlikely to appreciably reduce the survival and recovery of SONCC coho salmon at the diversity stratum or ESU scale. Implementation of the proposed action will maintain and promote processes that provide habitat for SONCC coho salmon and other species. While some juvenile mortality is expected, this impact will not appreciably alter the abundance of coho salmon populations in future years or appreciably affect long term population trends. Restoration projects are intended to restore degraded salmonid habitat and associated riparian zones; improve instream cover, pool habitat, and spawning gravel; remove barriers to fish passage; and reduce or eliminate erosion and sedimentation impacts. Although there will be short-term impacts to salmonid habitat, NMFS anticipates most projects will provide improvements to salmonid habitat over the long term and improve survival of local populations of salmonids into the future. The number of projects allowed annually by sideboards is conservative to ensure that effects of sediment and mortality producing activities are not additive. Restored habitat resulting from restoration projects should improve adult spawning success, juvenile survival, and smolt outmigration, which will in turn lead to improved abundance, productivity, spatial structure, and diversity within each affected coho salmon population. As individual population viability improves, the viability of the diversity strata and ESU will improve as well.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of SONCC coho salmon or destroy or adversely modify its designated critical habitat.

2.9 Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt

to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Incidental take" is defined by regulation as takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant (50 CFR 402.02). Section 7(b)(4) and section 7(o)(2) provide that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this ITS.

2.9.1 Amount or Extent of Take

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

Restoration Activities: NMFS expects that restoration activities will result in up to 2% of captured coho salmon juveniles killed at each relocation site. Up to 5% of coho salmon juveniles originally located within dewatered areas may be left behind and killed by crushing or desiccation. Up to 5% of coho salmon juveniles originally located within shallow water gravel augmentation sites may be killed by crushing.

It is not possible to quantify the amount of individual juvenile coho salmon suffering take as a result of increased suspended sediment and turbidity in the action area because the number of juvenile coho salmon that use the action area cannot be meaningfully measured and locating small, dead fish is extremely difficult due to predation, decomposition, and poor water visibility. In addition, juvenile distribution is not even across the action area, making it difficult to estimate the number of fish. When NMFS cannot quantify the amount or extent of incidental take in terms of the numbers of individuals, NMFS uses surrogates to estimate the amount or extent of incidental take. Therefore, we will use the expected maximum of 75 NTUs above background levels as measured 500 feet downstream of channel rehabilitation for 7 days following rewatering at any proposed construction site as a take surrogate. Higher levels of turbidity resulting from channel rehabilitation would result in effects to individual coho salmon from the proposed action that were not considered in this Opinion and take would be exceeded.

NMFS also anticipates incidental take of listed salmonids resulting from channelization of portions of streams. As noted in the Effects section, the amount of take resulting from channelized conditions caused by the proposed action at each future project site is difficult to estimate. Therefore, the habitat surrogate chosen to monitor the extent of this take is the length of bio-engineered streambank restored per project (streambank length must be less than 3x the active channel width), and the number of projects implemented per year (3). Furthermore, if bio-engineering techniques are not implemented per the proposed action, take would be considered exceeded.

Monitoring and Research Activities: Fish handling and take will occur with the implementation of fisheries research and monitoring activities (Table 2). Annual mortality from

all monitoring and research activities will not exceed 734 coho samon juveniles out of the maximum 20,310 coho salmon juveniles expected to be captured. Table 2 below summarizes the annual maximum capture and mortality from each type of monitoring and research activity.

Table 2. Annual maximum capture and mortality of coho salmon from proposed research and monitoring (Reclamation 2019).

Procedure/Method	Maximum Capture of Coho Salmon Juveniles	Maximum Mortality of Coho Salmon Juveniles
Rotary Screw Trap	12,500	1.8% of captured and not to exceed 225 individuals 3.2% of captured will be predated upon and not observable (up to 400 individuals)
Beach Seine, Fyke Net, Minnow Trap	3,800	1% of captured and not to exceed 38 individuals
PIT tag	5,500*	1% of captured and not to exceed 55 individuals
Tissue Sampling	3,500	0.03% of captured and not to exceed 1 individual
Electrofishing	500	3% of captured and not to exceed 15 individuals
Angler Survey	10	0
Total	20,310**	734

* Up to 2,000 of captured fish are from rotary screw trapping, and up to 3,500 are from beach seine, fyke net, and/or minnow traps.
** Total excludes overlap with fish that are trapped and also PIT tagged.

2.9.2 Effect of the Take

In the biological opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species or destruction or adverse modification of critical habitat.

2.9.3 Reasonable and Prudent Measures

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

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

1. Minimize the amount or extent of incidental take of listed salmonids resulting from restoration activity and associated capture and relocation of fish.

2. Minimize the amount or extent of incidental take of listed salmonids resulting from scientific research and monitoring.

3. Monitor the amount or extent of take to ensure take is not exceeded.

2.9.4 Terms and Conditions

The terms and conditions described below are non-discretionary, and the Reclamation or any applicant must comply with them in order to implement the RPMs (50 CFR 402.14). Reclamation or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If 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. TRRP, FWS, BLM, STNF, and/or the Corps (whichever federal agency is the lead for their particular project) shall use NOAA's Fall Transition Season Precipitation and Hydrology Decision Support Service notifications (contact Kathleen.Zontos@noaa.gov from the National Weather Service's Eureka, California office for weekly fall updates), as they become available, to ensure that any ground disturbing activity occurring after September 15 will be completed or fully winterized prior to the onset of fall rain to ensure project-related sediment mobilization will not reach the receiving waters.

    B. TRRP, FWS, BLM, STNF, and/or the Corps (whichever federal agency is the lead for their particular project) shall implement BMPs to prevent or minimize erosion and shall temporarily cease ground disturbing activities if NOAA's National Weather Service Quantitative Prediction Forecasts predict 1-inch or greater rainfall during one or more of their 6-hour prediction windows. Ground disturbing activities may resume when erosion control measures are adequate to minimize erosion and forecasts are less than 1 inch of rain during one or more of their 6-hour prediction windows.

    C. TRRP, FWS, BLM, STNF, and/or the Corps (whichever federal agency is the lead for their particular project) shall monitor turbidity (NTUs) immediately upstream (for baseline) and 500 ft downstream of instream restoration sites during instream construction until 7 days after rewatering the site. TRRP, FWS, BLM, STNF, and/or the Corps shall contact NMFS within 48 hours of discovering that incidental take of coho salmon has been met or exceeded (i.e., >75 NTUs above background at 500 ft downstream of the instream restoration site). Notify Roman Pittman or the North Coast Branch Chief at 707-822-7201 to discuss the activities resulting in take exceedance and to determine if additional protective measures are required.

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

    A. The TRRP shall ensure that all rotary screw traps are checked daily to remove debris and fish.

    B. The TRRP shall ensure that all sampling via angling will be carried out using barbless artificial flies and lures.

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

    A. TRRP, FWS, BLM, STNF, and the Corps shall allow any NMFS employee(s) or any other person(s) designated by NMFS, to accompany field personnel to visit their proposed restoration, monitoring and/or research projects.

    B. TRRP, FWS, BLM, STNF, and the Corps shall notify NMFS, as soon as possible, but no later than 48 hours, after any incidental take is exceeded for their project or if such an event is likely, and describe why the incidental take level was exceed or is likely to be exceeded.

    C. TRRP must provide annual reports to NMFS that summarize numbers of coho salmon juveniles captured or killed from the proposed restoration, monitoring, and research activities. Reports shall also include any analyses of scientific research data; any problems that may have arisen during implementation of the activities; and a statement as to whether or not the activities had any unforeseen effects. The reports shall be annually submitted to NMFS by February 15 at:

        NMFS – California Coastal Office
        Attn: North Coast Branch Supervisor
        1655 Heindon Road
        Arcata, California 95521

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 that the TRRP prepare and finalize a 5 or 10-year strategic plan that prioritizes their scientific monitoring and research activities. Such prioritization will help guide TRRP funding towards the most important and relevant monitoring and research that are consistent with the TRRP's goals and objectives.

2.11 Reinitiation of Consultation

This concludes formal consultation for the Trinity River Restoration Program's Mechanical Channel Rehabilitation, Sediment Management, Watershed Restoration, and Monitoring Actions.

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

2.12 "Not Likely to Adversely Affect"' Determinations

2.12.1 Effects on the Southern Resident Killer Whale DPS

The Southern Resident Killer Whale (SRKW) DPS is present throughout the coastal waters of Washington, Oregon, and Vancouver Island and are known to travel as far south as central California and as far north as the Queen Charlotte Islands, British Columbia. Designated critical habitat for SRKW is in the Strait of Juan de Fuca, Puget Sound, and the San Juan Islands, none of which are in the action area. In the summer months, the distribution of SRKW is generally near the San Juan Islands. During the winter months they travel along the Pacific Coast as far south as Point Reyes, California. The major prey base for SRKW is Chinook salmon, with other species such as coho salmon or chum salmon being seasonally or regionally important (NMFS 2015a). Though rarely detected in SRKW fecal samples, they are thought to consume Steelhead occasionally (NMFS 2015a).

SRKW do not occupy the action area. As previously described, they primarily occur in the inland waters of Washington State and southern Vancouver Island, although individuals from this population have been observed off coastal California in Monterey Bay, near the Farallon Islands, and off Point Reyes (NMFS 2008). SRKW survival and fecundity are correlated with Chinook salmon abundance (Ward et al. 2009, Ford et al. 2009). Many salmon populations are at risk, with 9 ESUs of Chinook salmon listed as threatened or endangered under the ESA. The proposed action does impact a limited number of juvenile Chinook salmon resulting from research and monitoring activities. As stated earlier, mortality from tagging, trapping, and angling activities will be minimized by employment of multiple mitigation measures and any loss of juvenile Chinook salmon is not expected to appreciably alter the abundance of the population in future years or appreciably affect population trends. Because the TRRP program is expected have negligible adverse impacts on the Chinook salmon populations in the Klamath Basin and an overall beneficial effect by increasing local populations of Chinook salmon over the long term, we concur that the proposed action is not likely to adversely affect the SRKW.

2.12.2 Effects on the Southern DPS of Pacific Eulachon

Historically, large aggregations of eulachon were reported to have consistently spawned in the Klamath River. Allen et al. (2006) indicated that eulachon usually spawn no further south than the Lower Klamath River and Humboldt Bay tributaries. The California Academy of Sciences ichthyology collection database lists eulachon specimens collected from the Klamath River in February 1916, March of 1947, and 1963, and in Redwood Creek in February 1955. During spawning, fish were regularly caught from the mouth of the river upstream to Brooks Riffle, near the confluence with Omogar Creek (Larson and Belchik 1998), indicating that this area contains the spawning and incubation, and migration corridor essential features. Peak spawning migration in the Klamath River occurs between March and April (Larson and Belchik 1998) and that eulachon begin migration in the Klamath in January in small numbers (Young 1984).

The only reported commercial catch of eulachon in northern California occurred in 1963 when a combined total of 56,000 pounds was landed from the Klamath River, the Mad River, and Redwood Creek (Odemar 1964). Since 1963, the run size has declined to the point that only a few individual fish have been caught in recent years. However, in January 2007, six eulachon were reportedly caught by tribal fishers on the Klamath River. Another seven eulachon were captured between January and April of 2011 at the mouth of the Klamath River (McCovey 2011).

The proposed action is not expected to significantly alter the ecological relationship between salmon and eulachon or the physical, chemical, and biological features in the Klamath River and estuary where eulachon are found. Research activities occurring in the lower Klamath will not impact habitat and with the low numbers of eulachon, incidental catch is not expected. While the proposed restoration actions may increase suspended sediment concentrations, they are expected to be minor and short-lived, and are unlikely to cumulatively combine within downstream habitat when multiple projects occur in one watershed. Furthermore, any minor sediment effects that do convey to the estuary environment or the Klamath River will quickly dissipate within the larger spatial area of the receiving water body. Proposed restoration is likely to improve habitat and increase the number of juvenile salmonids that may prey upon eulachon. However, given the relatively limited spatial overlap between coho salmon smolts and larval eulachon within the action area, and the small quantity of eulachon in the action area, predation on eulachon by salmonid juveniles is extremely unlikely to occur and is considered discountable. Therefore, we concur that the proposed action is not likely to adversely affect the SDPS eulachon or its critical habitat.

2.12.3 Effects on the Southern DPS of North American Green Sturgeon

While the Southern DPS of North American green sturgeon (SDPS green sturgeon) have not been documented in the action area, according to NMFS, the presence of SDPS green sturgeon is likely (based on limited records of confirmed Northern DPS fish or green sturgeon of unknown DPS), but not confirmed within the Klamath/Trinity River estuary.

Adult and sub-adult SDPS green sturgeon may be present in the Trinity River and Klamath River estuary in the summer and fall. There is no designated critical habitat in the Klamath or Trinity rivers for SDPS green sturgeon; however, the near shore area of the action area off the Pacific coast is designated critical habitat. Any minor increases in suspended sediment concentrations that convey to the estuary environment or the Klamath River will quickly dissipate within the larger spatial area of the receiving water body. An expected increase in production of salmonid juveniles from the proposed action may be a benefit for SDPS green sturgeon as a food source, particularly if they perish and become food for this bottom-feeding species. Research activities in the Lower Klamath will not impact habitat and because of low numbers of green sturgeon, incidental catch is not anticipated. For the reasons listed above, the effects of the proposed action on SDPS green sturgeon are considered discountable. Therefore, we concur that the proposed action is not likely to adversely affect the SDPS green sturgeon.

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

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

This analysis is based, in part, on the EFH assessment provided by the Reclamation and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans 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 River 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, critical habitat described previously. The adverse effects to EFH and HAPCs in the action area include:

1. Bank stabilization that inhibits channel movement, erosion and introduction of alluvium to the channel, and other naturally occurring processes that form habitat.

2. Short term increases in suspended sediment concentrations and turbidity downstream of major channel reconstruction projects.

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 Reclamation 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 the Trinity River Restoration Program, Fish and Wildlife Service, Shasta-Trinity National Forest, Bureau of Land Management, and the Corps. Other interested users could include TRRP partners, resource conservation districts, restoration practitioners, stakeholders, and others interested in the conservation of the affected ESU. Individual copies of this opinion were provided to the Trinity River Restoration Program, Fish and Wildlife Service, Shasta-Trinity

National Forest, Bureau of Land Management, and the Corps. 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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