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

October 14, 2022 **Refer to NMFS No:** WCRO-2022-01004

Jim Mazza
Chief, Regulatory Division
U.S Department of Army
San Francisco District, Corps of Engineers
450 Golden Gate Avenue, 4th Floor, Suite 0134
San Francisco, California 94102-3406

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Humboldt Bay Municipal Water District's Maintenance in the Mad River in Humboldt and Trinity Counties, California (SPN-2003-286620)

Dear Mr. Mazza:

Thank you for your letter of April 21, 2022, 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 Humboldt Bay Municipal Water District's maintenance in the Mad River in Humboldt and Trinity counties, California (Project).

On July 5, 2022, the United States District Court for the Northern District of California issued an order vacating the 2019 regulations adopting changes to 50 CFR part 402 (84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. As a result, the 2019 regulations are once again in effect, and we are applying the 2019 regulations here. For purposes of this consultation, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act [16 U.S.C. 1855(b)] for this action. NMFS has provided EFH conservation recommendations for the Project and requests a response to these recommendations within 30 days of receipt of this letter.

NMFS has determined that the proposed action will adversely affect listed species and their critical habitats and has provided an incidental take statement.

Please contact Dan Free in our Arcata, California Office at Dan.Free@noaa.gov or (707) 825-5164 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

ec: Kasey Sirkin, Corps, Eureka, CA
John Friedenbach, HBMWD, Eureka, CA
Copy to file: FRN 151422WCR2022AR00149

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

Humboldt Bay Municipal Water District's Maintenance in the Mad River in Humboldt and Trinity Counties, California

NMFS Consultation Number: WCRO-2022-01004
Action Agency: 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 Coho Salmon (*Oncorhynchus kisutch*)	Threatened	Yes	No	Yes	No
California Coastal Chinook (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
Northern California Steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Southern Distinct Population Eulachon (*Thaleichthys pacificus*)	Threatened	Yes	No	Yes	No
Southern Distinct Population Green Sturgeon (*Acipenser medirostris*)	Threatened	No	N/A	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	Yes

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

Issued By:

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Date: October 14, 2022

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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 U.S.C. 1531 et seq.), as amended, and implementing regulations at 50 CFR part 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson–Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR part 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 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at NMFS' Northern California Office in Arcata, California.

1.2. Consultation History

On March 10, 2005, NMFS issued a biological opinion (BiOp) and incidental take statement (ITS) on the Humboldt Bay Municipal Water District's (HBMWD) habitat conservation plan (HCP) and issued a section 10(a)(1)(a) incidental take permit (ITP) for the HCP. That BiOp and ITS only covered SONCC coho salmon and their critical habitat, CC Chinook salmon, and NC steelhead, but not their critical habitats. Since the Southern Distinct Population Segment of eulachon had not been listed, it was not included as a covered species in the HCP or ITP.

The HBMWD applied to the U.S. Army Corps of Engineers (Corps) in 2010 for a section 404 Clean Water Act permit for their activities that would result in the filling of wetlands, which required additional section 7(a)(2) consultation with NMFS. NMFS completed this consultation on August 20, 2010, with the issuance of a BiOp and ITS that covered the years 2010-2020.

On April 21, 2022, the Corps requested initiation of section 7 consultation with NMFS for HBMWD's proposed maintenance activities in the Mad River.

On July 5, 2022, the United States District Court for the Northern District of California issued an order vacating the 2019 regulations adopting changes to 50 CFR part 402 (84 FR 44976, August 27, 2019). This consultation was initiated when the 2019 regulations were still in effect. As reflected in this document, we are now applying the section 7 regulations that governed prior to adoption of the 2019 regulations. For purposes of this consultation, we considered whether the substantive analysis and its conclusions regarding the effects of the proposed action articulated in the biological opinion and incidental take statement would be any different under the 2019 regulations. We have determined that our analysis and conclusions would not be any different.

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 (see 50 CFR 402.02). The Corps proposes to issue a section 404 Clean Water Act permit for a period of ten years to the HBMWD for activities associated with the maintenance of their facilities.

We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would cause the following activities: facilitate continuance of the operation of Matthews Dam and the water diversion and pumping facility. However, these activities were covered under an existing section 10(a)(1)(a) ITP and therefore, will be described in the environmental baseline of this BiOp.

Under the MSA, "Federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal agency (see 50 CFR 600.910).

1.3.1 Purpose of the Proposed Action

The HBMWD provides water to over 88,000 people in the Humboldt Bay area and sells water to industrial users on the Samoa Peninsula. The HBMWD's source of water is Ruth Lake, a 48,000-acre-foot reservoir, located approximately 84 mi upstream from the mouth of the Mad River. Water is released from the lake through Matthews Dam to supply the HBMWD's diversion facilities, which are located approximately 75 mi downstream (Figure 1). The HBMWD diverts water at Essex through two separate systems. Water for industrial uses is supplied by a surface diversion facility (Station 6). Domestic water is supplied from four Ranney collectors (Stations 1, 2, 3, and 4) that draw water from 60–90 feet (ft) below the riverbed. Although Station 5 is currently inoperable, the HBMWD may activate this station during the permit period. The HBMWD has a section 10(a)(1)(a) ITP with the NMFS on the operations that covers the storage, release, and diversion of water in the Mad River. This BiOp covers the maintenance activities to support the HCP.

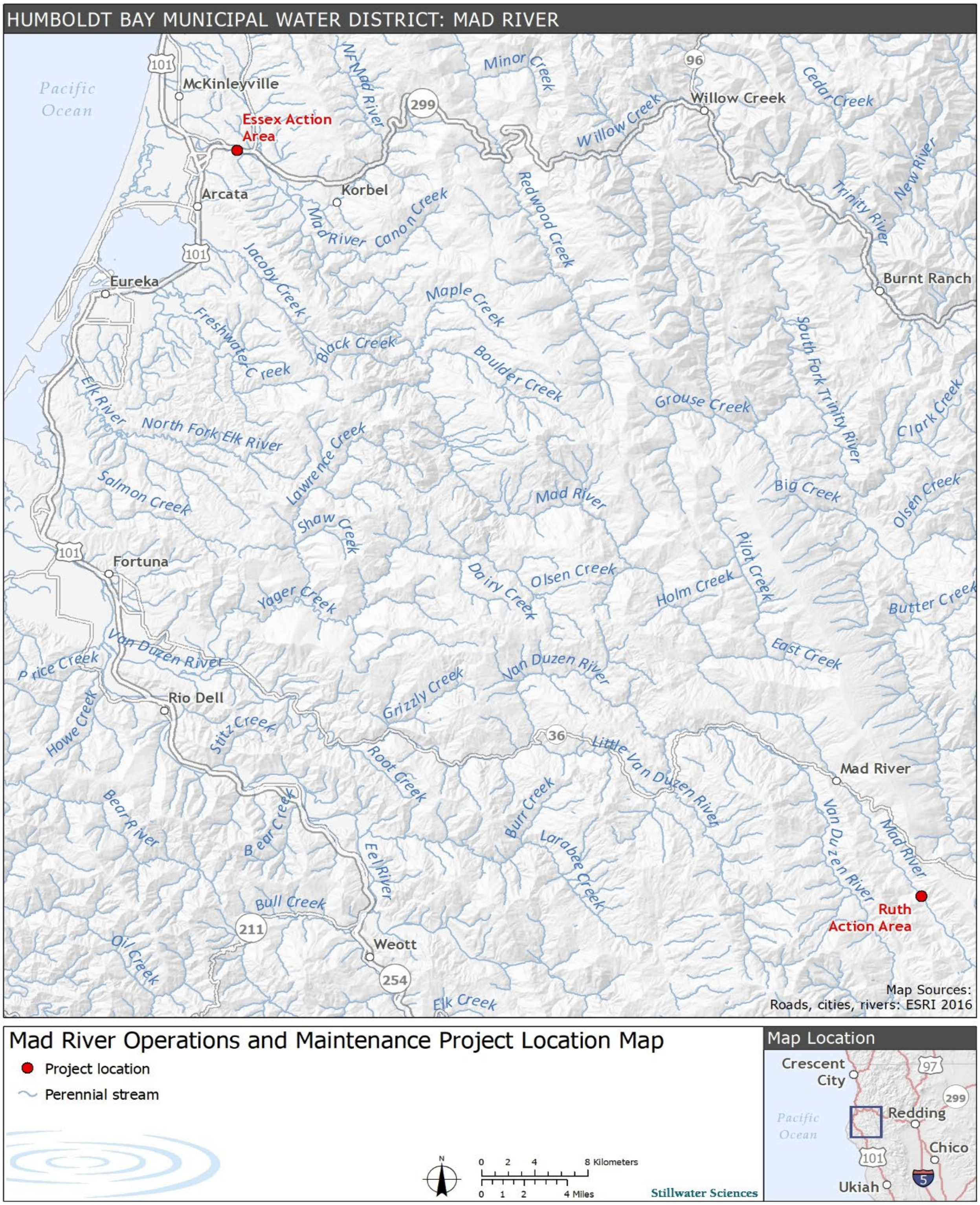

Figure 1. Location of the HBMWD's facilities within the Mad River watershed.

The HBMWD's facilities at Ruth and Essex are located within or adjacent to the active channel of the Mad River and require periodic maintenance and repair to maintain operability. These activities include maintaining flow toward Station 6 (Figure 2), constructing access to the Ranney collectors (Figure 2), flushing the collectors (Figure 2), restoring capacity in the dam tailrace and spillway plunge pool (Figure 3), and repairing revetments and rock structures (Figures 2 and 3). The objective of these activities is to continue supplying industrial and domestic water to the Humboldt Bay area.

1.3.2 Proposed Maintenance Activities

1.3.2.1 Berm Construction

In 1991, The HBMWD constructed a rock jetty and weir to maintain the water elevation surface to allow for the surface diversion at station 6. Every spring and early summer, additional temporary grade control is constructed in the river from gravel taken from the adjacent gravel bar to maintain the water surface elevation at Station 6. The constructed berm is approximately 350 feet in length, 20 feet wide, and 4-feet high and is approximately 1,050 cubic yards in volume. The berm may not be constructed each year unless necessary. This activity was last completed in 2006.

A fish biologist shall conduct pre- and post-construction fish surveys of the work area extending from Station 6 down to Highway 299. The pre-construction survey will occur no earlier than 10 days prior to construction. The post-construction survey will occur no later than 30 days following construction. At least one week prior to the planned construction, the HBMWD will convene a meeting with the Corps, NMFS, and other interested agencies to develop a plan to minimize effects on listed salmonids and other fish species. The HBMWD will provide the results of the pre-construction investigations and a description of the planned construction at this meeting.

During in-water construction, the diversion at station 6 will be operated to divert as much turbid water and suspended sediment as possible. Berm construction will require the use of excavators, bulldozers, and other heavy equipment within the flowing water and on the gravel bar. Gravel will be removed from the bar from an excavation no lower than the silt line or approximately 1 to 2 feet above the water surface. Additionally, the excavation will not encroach further than below 1/3rd of the head or top of the bar and the bar will be graded to be free-draining. Silt curtains will be used to contain turbidity and suspended sediment, where possible. During construction, a fish biologist will be present and shall remove and exclude fish from the work area. Prior to any crossings of the wetted channel, a fish biologist shall remove and exclude fish from the proposed crossing. The berm construction will be completed in one day.

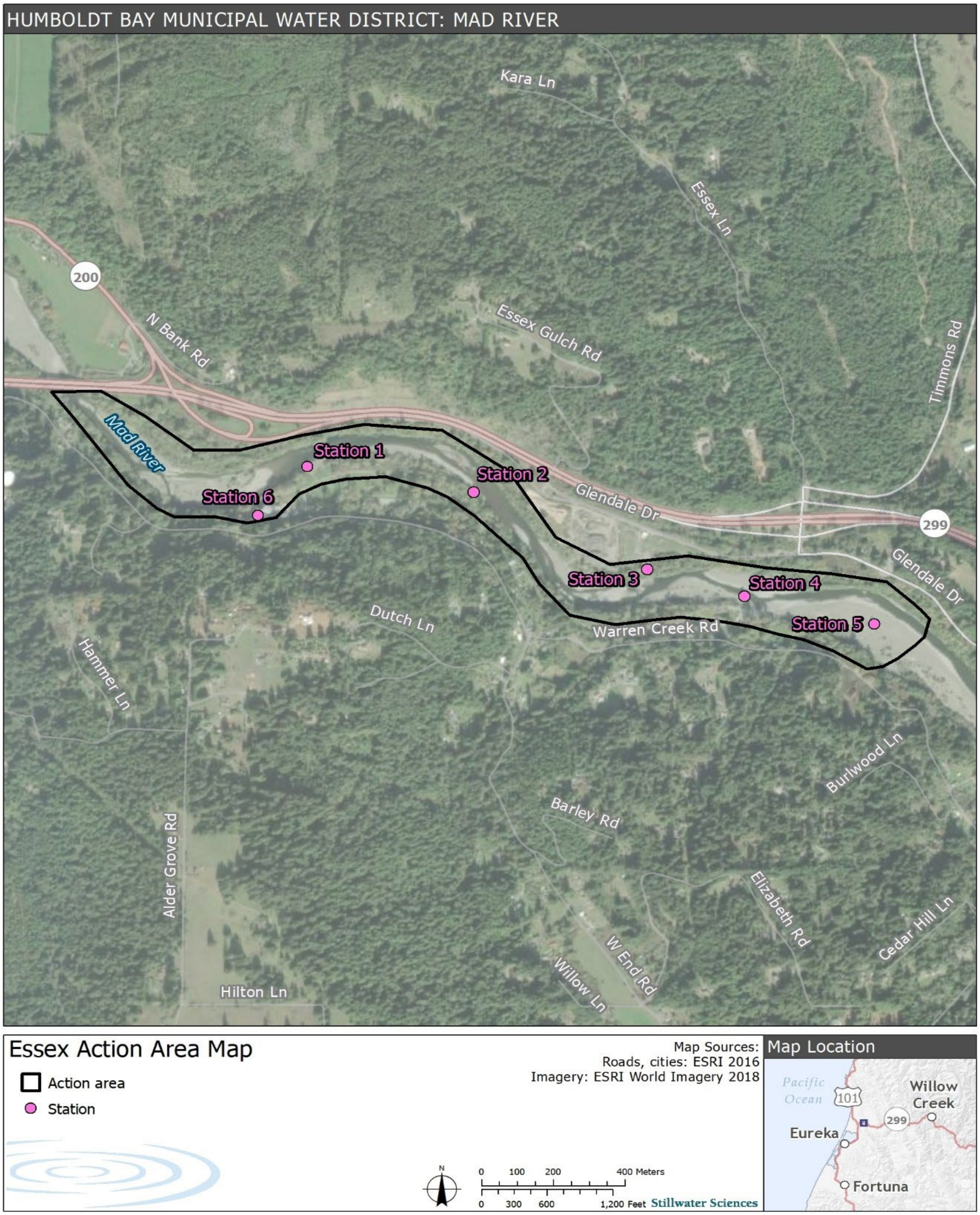

Figure 2. The downstream action area near Arcata, California (Stillwater Sciences 2022).

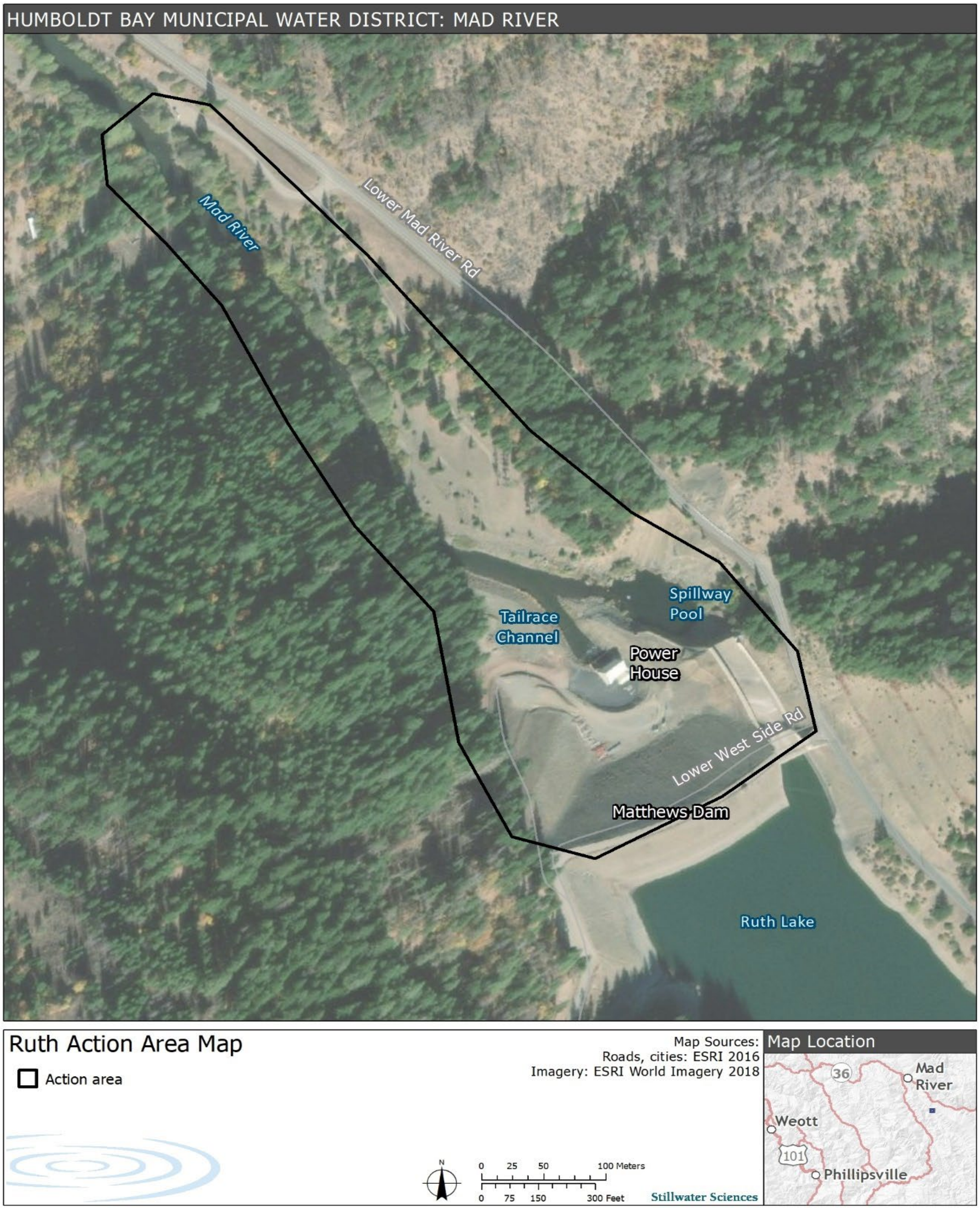

Figure 3. Upstream action area below Matthews Dam near Ruth, California in Trinity County (Stillwater Sciences 2022).

1.3.2.2 Trench Construction

Each year, the HBMWD must assess changes to channel morphology in front of Station 6. Depending on the magnitude and duration of high winter flows, coarse sediment may accumulate upstream of the rock weir and/or directly in front of Station 6. If aggradation occurs, it may block the forebay entrance and limit exchange of water with the low flow channel. If this occurs, excavation of the aggraded material and/or creation of a channel along the south bank becomes necessary. The aggraded gravel must be removed before it causes a bar to form, which would block the entrance to the forebay and cause the thalweg to shift to the center of the channel. This activity is only conducted during those years when flow patterns make it necessary and the entire construction period generally lasts between one and two hours. This activity was last conducted in 2018.

The configuration and extent of the excavation varies depending on the amount of material that has aggraded in front of Station 6 and its relation to the low flow channel. Excavation of a trench may occur near the south bank between stations 1 and 6, as needed, to maintain adequate flow to Station 6. This method is preferred over berm construction. Excavation may also occur in front of Station 6 if aggradation is sufficient to block the forebay entrance and limit exchange of water with the low-flow channel. The wetted channel excavation would range from 200–500 ft long, 10–20 ft wide, and 3–6 ft deep. The excavated volume of gravel would be between 275 and 2,225 cubic yards. Excavated gravel is placed on the left bank and trucked away, as necessary.

A fish biologist shall conduct pre- and post-construction surveys of the work area extending from Station 6 down to Highway 299. The pre-construction survey will occur no earlier than 10 days prior to construction. The post-construction survey will occur no later than 30 days following construction. At least one week prior to the planned construction, the HBMWD will convene a meeting with the Corps, NMFS, and other interested agencies to develop a plan to minimize effects on listed salmonids and other fish species. The HBMWD will provide the results of the pre-construction investigations and a description of the planned construction at this meeting.

During construction and prior to any crossings of the wetted channel, a fish biologist shall make every effort to remove and exclude fish from the work area or proposed crossing. Station 6 will be operated during trench construction to reduce turbidity and suspended sediment delivery downstream.

1.3.2.3 Ranney Collector Repair and Maintenance

Construction of temporary access roads, platforms, ramps, or gravel berms to Ranney Collector stations 1, 2, 4, and 5 are necessary for the testing, repair, or maintenance of equipment housed within the facilities. This would occur on an as-needed basis and consists of the following activities. These activities would occur during the summer low-flow period (June 30th to September 15).

1.3.2.3.1 Construction of Gravel Access Roads to Stations 1, 2, 4 and 5

When pumps, infiltration galleries, or other equipment at Stations 1, 2, 4, and 5 need repair or maintenance, temporary roads would be constructed by pushing river-run gravel from the surrounding dry bars by bulldozer, backhoe, or other heavy equipment. The roads would be constructed outside of the low-flow channel from the top of bank to the riverbed (approximately 120 ft long and 17 ft wide). Once on the dry bar, a temporary road would be constructed to the station that would be approximately 300–750 ft long. The estimated volume of aggregate needed would be approximately 8,000 cubic yards and taken from the on-site dry gravel bar. This material would remain in the active channel for redistribution at high flows.

Construction of the dry bar access road would occur outside of the low flow channel. However, river morphological conditions may require limited encroachment into the wetted channel to provide access for equipment. A fish biologist will be present to move any fish into deeper water that might be in the edgewater area and could potentially be affected by the temporary road construction.

1.3.2.3.2 Construction of Gravel Access Platforms and Ramps

When pumps or other equipment at Stations 1, 2, 4 and 5 need repair or maintenance, an access ramp would be constructed to facilitate maintenance or repair activities in the collectors at station 1, 2, 4, and 5. The ramp would extend from the elevation of the dry streambed to 2 feet below the valve deck. Depending on channel topography, the ramp would be 75–200 feet in length and 10 to 20 feet in height. The ramp would be about 17 feet wide, with a 25 foot by 25 foot platform at the top for placement of a crane. Estimated fill volume is between 1,600 and 2,600 cubic yards. The fill would come from adjacent dry gravel bars. Most of this fill would remain to be naturally redistributed during higher winter flows.

Construction of the platforms and ramps would occur outside of the low flow channel. However, river morphological conditions may require limited encroachment into the wetted channel to construct the platform. A fish biologist will be present to move any fish into deeper water that might be in the platform footprint and could potentially be affected by construction.

1.3.2.3.3 Construction of Berms Adjacent to Stations 1, 2, 4, and 5

To allow for periodic flushing of the stations' collector laterals, a berm may be constructed by pushing riverbed material around each collector to a height of 3–4 feet. The exact length and configuration of the berm would depend on the location of the river shoreline in relation to the collector flushing discharge. The berm would be removed when flushing is completed, and the discharged river water has percolated back through the riverbed. Estimated fill volume would be 50–100 cubic yards per collector.

1.3.2.3.4 Maintenance and Repairs to Existing Rock Structures in the Essex Reach

This activity involves placement of ¼–1 ton rock to maintain or repair the following existing structures:

- The Grade control weir downstream of Station 6, which consists of between 3,500–5,000 cubic yard of ¼–1 ton rock and gravel. The weir's design will be maintained in conformance with California Department of Fish and Wildlife (CDFW) and NMFS specifications to maintain fish passage.

- Rock jetties in the vicinity of Stations 1 and 6 consisting of between 3,500–5,000 cubic yard of ¼–1 ton rock and gravel per jetty.
- Bank revetments along the right and left banks at various locations in the Essex reach. The revetments are between 200 and 800 feet long and consist of ¼–1 ton rock.
- Maintenance of existing riprap around Station 1 and its discharge line, around Stations 2 and 4, and the hydraulic control structure at Station 6.

Maintenance and repair of rock structures and revetments in the Essex action area would occur infrequently. The actual means and methods to conduct these actions would depend on the river configuration at the time work is being planned. For example, if the river thalweg is away from the maintenance or repair location, then all work may be completed without entering the wetted channel. If the operations site is within the wetted channel, then there may be a need to dewater the work area and move fish out of harm's way. In any event, the Corps, NMFS, and other regulatory agencies would be consulted during the planning process and prior to any construction.

1.3.2.3.5 Station 6 Forebay Dredging

The HBMWD proposes to dredge/excavate accumulated silt or debris deposited in the forebay and the river bottom directly in front of the forebay at Station 6. This activity occurs each year, and mainly in the winter when background turbidity in the river is very high. The frequency of dredging varies based on the frequency and severity of winter storms, but typically ranges from two to five times per month during the winter. The dredging would also be performed during the summer low flow season on an infrequent basis when it is necessary to conduct maintenance on the fish screens.

Dredging the accumulated silt requires the HBMWD's long-reach excavator to sit on dry land at the top of the forebay, extend the bucket and boom over the side, reach down into the water, and extract one bucket-full at a time. The excavated silt and debris are immediately deposited in a temporary stockpile outside of the forebay before being trucked off-site.

The forebay dredging area encompasses approximately 10,000 square feet (Friedenbach 2022). The amount of sediment removed will vary, but may be up to 500 cubic yards per dredging event. Significantly less material would be removed to provide access to the fish screens during the summer.

1.3.2.3.6 Tailrace and Spillway Sediment Removal below Matthews Dam

Bank erosion resulting from high water events passing over the spillway periodically results in deposition of sediment in the plunge pool or tailrace channel outlet, which can affect channel hydraulics. This sediment deposition requires periodic excavation of approximately 250 cubic yards of aggraded material from the tailrace channel and spillway pool below Matthews Dam. The tailrace channel, subject to siltation and gravel deposits, covers an area of approximately 44 feet by 220 feet. The spillway plunge pool area that would be subject to sediment removal is approximately 40 feet by 440 feet. Sediment removed from the tailrace and plunge pool is stored on HBMWD property at a distance sufficient to ensure no sediment is delivered to the Mad River during storm events.

Work will be conducted during summer low flow conditions and dry weather when no water is spilling over the spillway and the powerhouse is operating a single turbine. Excavation would be conducted using excavators, front end loaders, backhoes, and other suitable equipment. All heavy equipment would be inspected for leaks, which would be repaired (if any are found) prior to any equipment entering the water.

1.3.2.3.7 Maintenance and Repair of Existing Rock Revetments in the Tailrace and Spillway Plunge Pool below Matthews Dam

Existing rock revetments present in the tailrace channel outlet and spillway plunge pool require periodic maintenance and repair using ¼ to 1 ton rock. This element of the proposed action is expected to occur infrequently. For example, the riprap on the left channel side of the plunge pool was installed in 1997 and repaired in 2006.

Work within the Ruth action area will be conducted during summer low flow conditions and dry weather. Placement of rock structures shall be done using an excavator and in such a manner that it occupies the minimum possible area of the low-flow channel and minimizes impacts on riparian vegetation. The HBMWD will install silt fences, hay bales, or other appropriate devices during revetment repair to minimize sediment or other debris from entering the Mad River downstream of the dam. Streambanks disturbed during revetment repair will be restored with willow mattresses, geo-textile, and/or pre-existing vegetative cover.

1.3.3 Measures to Minimize Impacts to Listed fish Species and Their Critical Habitats

The HBMWD will implement a number of measures to minimize impacts from the proposed action. These include:

1) Establishment of an in-water work between June 30 and September 15, except for the Essex forebay dredging, which occurs during the winter.
2) With the exception of the forebay dredging, meeting with the Corps and NMFS at least one week prior to initiating any in-channel activities.
3) Utilizing a fish biologist to assess a project site and develop a plan for dewatering and fish removal/relocation, if necessary.
4) Operating Station 6 pumps as much as possible to draw in turbid water and suspended sediment during in-water activities to reduce downstream discharge.
5) Inspection of Station 6 forebay for adult summer steelhead prior to dredging.
6) Agitating the water in the forebay with the excavator bucket to promote fish movement out of the path of the bucket prior to digging.
7) Use of a seine net to herd fish out of the excavation area prior to dredging.
8) All heavy equipment fueling and maintenance shall occur outside the bankfull channel and equipment will be cleaned prior to entering the active channel.
9) Grading any gravel bars used as aggregate sources for the actions above so that they will be left in a smooth free-draining configuration upon completion of the specific project.
10) Riparian vegetation removal in the spillway plunge pool, tailrace, and revetments will be minimized to the maximum extent practicable while still allowing for completion of the activity.

11) Erosion control measures (silt fences, straw wattles, etc.) will be installed on bare mineral soils during any activities that have the potential to result in sediment delivery to the Mad River channel.

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 to adversely modify or destroy their designated critical habitat. Per the requirements of the ESA, Federal action agencies consult with NMFS, and section 7(b)(3) requires that, at the conclusion of consultation, NMFS provide an opinion stating how the agency's actions would affect listed species and their critical habitats. If incidental take is reasonably certain to occur, section 7(b)(4) requires NMFS to provide an ITS that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) and terms and conditions to minimize such impacts.

The Corps determined the proposed action is not likely to adversely affect the southern DPS green sturgeon (*Acipenser medirostris*). Designated critical habitat for green sturgeon does not occur in the Mad River. Our concurrence is documented in the "Not Likely to Adversely Affect" Determination section (Section 2.12).

2.1. Analytical Approach

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

This biological opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species" (50 CFR 402.02).

The designations of critical habitat for SONCC coho salmon, CC Chinook salmon, NC steelhead, and eulachon uses the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR part 424) 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 ESA Section 7 implementing regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision 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 critical habitat using an exposure–response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species; or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

2.2. Rangewide Status of the Species and Critical Habitat

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

The following species and their designated critical habitats are likely to be adversely affected by the proposed action:

Threatened Southern Oregon/Northern California Coast coho salmon Evolutionarily Significant Unit (ESU) (*Oncorhynchus kisutch*)
Listing determination (70 FR 37160, June 28, 2005)
Critical habitat designation (64 FR 24049, May 5, 1999);

Threatened California Coastal (CC) Chinook salmon ESU (*O. tshawytscha*)
Listing determination (70 FR 37160, June 28, 2005)
Critical habitat designation (70 FR 52488, September 2, 2005);

Threatened Northern California (NC) steelhead Distinct Population Segment (DPS) (*O. mykiss*)
Listing determination (71 FR 834, January 5, 2006)
Critical habitat designation (70 FR 52488, September 2, 2005);

Threatened Southern DPS eulachon (*Thaleichthys pacificus*)
Listing determination (75 FR 13012, March 18, 2010)
Critical habitat designation (76 FR 65323, December 19, 2011).

2.2.1 Life History and Range

2.2.1.1 Coho Salmon

Coho salmon adults migrate to and spawn in small streams that flow directly into the ocean, or tributaries and headwater creeks of larger rivers (Sandercock 1991, Moyle 2002). Adults migrate upstream to spawning grounds from September through late December, peaking in October and November. Spawning occurs mainly November through December, with fry emerging from the gravel in the spring, approximately three to four months after spawning. Juvenile rearing usually occurs in tributary streams with a gradient of 3 percent or less, although they may move up to streams of 4 percent or 5 percent gradient. Juveniles have been found in streams as small as 1 to 2 meters wide. They may spend one to two years rearing in freshwater (Bell and Duffy 2007), or emigrate to an estuary shortly after emerging from spawning gravels (Tschaplinski 1988). With the onset of fall rains, coho salmon juveniles are also known to redistribute into non-natal rearing streams, lakes, or ponds, where they overwinter (Peterson 1982). At a length of 38–45 mm, fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Sandercock 1991, Nickelson et al. 1992). Emigration from streams to the estuary and ocean generally takes place from March through June.

The SONCC coho salmon ESU includes all naturally spawned populations of coho salmon in coastal streams from the Elk River, Oregon, through the Mattole River, California. It also includes three artificial propagation programs: Cole Rivers Hatchery in the Rogue River Basin, and the Trinity and Iron Gate hatcheries in the Klamath-Trinity River Basin.

2.2.1.2 Chinook Salmon

Chinook salmon follow the typical life cycle of Pacific salmon in that they hatch in freshwater, migrate to the ocean, and return to freshwater to spawn. However, diversity within this life cycle exists in the time spent at each stage. Juvenile Chinook salmon are classified into two groups, ocean-type and stream-type, based on the period of freshwater residence (Healey 1991). Ocean-type Chinook salmon spend a short period of time in freshwater after emergence, typically migrating to the ocean within their first year of life. Stream-type Chinook salmon reside in freshwater for a longer period, typically a year or more, before migrating to the ocean. After emigration, Chinook salmon remain in the ocean for two to five years (Healey 1991) tending to stay in the coastal waters of California and Oregon. Chinook salmon are also characterized by the timing of adult returns to freshwater for spawning, with the most common types referred to as fall-run and spring-run fish. Typically, spring-run fish have a protracted adult freshwater residency, sometimes spawning several months after entering freshwater, and produce stream-type progeny. Fall-run fish spawn shortly after entering freshwater and generally produce ocean-type progeny. Historically, both spring-run and fall-run fish existed in the CC Chinook salmon ESU. At present, only fall-run fish appear to be extant in the ESU.

Fall-run Chinook salmon are decidedly ocean-type (Moyle 2002), specifically adapted for spawning in lowland reaches of big rivers and their tributaries (Moyle 2002, Quinn 2005). Adults move into rivers and streams from the ocean in the fall or early winter in a sexually mature state and spawn within a few weeks or days upon arrival on the spawning grounds (Moyle 2002). Juveniles emerge from the gravel in late winter or early spring and within a matter of months, migrate downstream to the estuary and the ocean (Moyle 2002, Quinn 2005). This life history strategy allows fall-run Chinook salmon to utilize quality spawning and rearing areas in the valley reaches of rivers, which are often too warm to support juvenile salmonid rearing in the summer (Moyle 2002).

The CC Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from rivers and streams south of the Klamath River (exclusive) to the Russian River (inclusive). Seven artificial propagation programs are considered part of the ESU: the Humboldt Fish Action Council (Freshwater Creek), Yager Creek, Redwood Creek, Hollow Tree, Van Arsdale Fish Station, Mattole Salmon Group, and Mad River Hatchery fall-run Chinook hatchery programs, but these programs were discontinued over a decade ago.

2.2.1.3 Steelhead

Steelhead probably have the most diverse life history of any of any salmonid (Quinn 2005). There are two basic steelhead life history patterns: winter-run and summer-run (Quinn 2005, Moyle 2002). Winter-run steelhead enter rivers and streams from December to March in a sexually mature state and spawn in tributaries of mainstem rivers, often ascending long distances (Moyle 2002). Summer steelhead (also known as spring-run steelhead) enter rivers in a sexually immature state during receding flows in spring, and migrate to headwater reaches of tributary streams where they hold in deep pools until spawning the following winter or spring (Moyle 2002). Spawning for all runs generally takes place in the late winter or early spring. Eggs hatch in 3 to 4 weeks and fry emerge from the gravel 2 to 3 weeks later (Moyle 2002). Juveniles spend 1 to 4 years in freshwater before migrating to estuaries and the ocean where they spend 1 to 3 years before returning to freshwater to spawn.

Another expression of the life history diversity of steelhead is the “half pounder” - sexually immature steelhead that spend about 3 months in estuaries or the ocean before returning to lower river reaches on a feeding run (Moyle 2002). Half pounders then return to the ocean where they spend 1 to 3 years before returning to freshwater to spawn. This steelhead life history form has only been observed in the Rogue and Klamath Rivers (of the Klamath Mountain Province Steelhead DPS) and the Mad and Eel Rivers (of the NC Steelhead DPS, Busby et al. 1996). Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby et al. 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Busby et al. 1996). Some steelhead "residualize," as juveniles, becoming resident trout and never adopting the anadromous life history.

The NC steelhead DPS includes all naturally spawned populations of steelhead in California coastal river basins from Redwood Creek (inclusive) southward to the Russian River (exclusive). Two artificial propagation programs are considered part of the DPS: the Yager Creek Hatchery and the North Fork Gualala River Hatchery (Gualala River Steelhead Project), but these programs were discontinued over a decade ago.

2.2.1.4 Eulachon

Eulachon are an anadromous (moving between freshwater and saltwater) smelt in the family Osmeridae. Eulachon spend over 95% of their life in the Pacific Ocean. At 2 to 5 years of age, adult eulachon ascend the lower portion of coastal rivers typically in the winter when rivers are the coldest (below 10 degrees Celsius) to spawn. Most eulachon are semelparous and die after spawning. Females release from 7,000 to 60,000 1mm eggs over sand and gravel which become adhesive after fertilization. The fertilized eggs hatch after 3 to 8 weeks depending on temperature and the 4 mm to 8 mm larvae are swept downstream to estuaries for short-term rearing before entering the ocean and dispersing on the continental shelf where they feed on planktonic crustaceans including copepods, cumaceans, and euphasiids or krill, their primary prey.

The Southern DPS of Eulachon is listed as threatened under the ESA and occurs in the California current and spawns in rivers from the Mad River in California to the Skeena River in British Columbia.

2.2.2 Status of the Species

2.2.2.1 SONCC Coho Salmon

The following summary is from Williams et al. 2016, the most recent biological viability report for SONCC coho salmon:

Although long-term data on coho abundance in the SONCC Coho Salmon ESU are scarce, all available evidence from more recent trends since the 2011 assessment (Williams et al. 2011) indicate little change since the 2011 assessment. The two population-unit scale time series for the ESU both have a trend slope not different from zero. The composite estimate for the Rogue Basin populations was not significantly different from zero ($p > 0.05$) over the past 12 years and significantly positive over the 35 years of the data set ($p = 0.01$). The continued lack of appropriate data remains a concern, although the implementation of the Coastal Monitoring Program (CMP) for California populations is an extremely positive step in the correct direction in terms of providing the types of information to assess and evaluate population and ESU viability. The lack of population spatial scale monitoring sites in Oregon is of great concern and increases the uncertainty when assessing viability. Additionally, it is evident that many independent populations are well below low-risk abundance targets, and several are likely below the high-risk depensation (depensation is a decline in growth rate of a population that results from very low populations sizes) thresholds specified by the TRT and the Recovery Plan (NMFS 2014). Though population-level estimates of abundance for most independent populations are lacking, it does not appear that any of the seven diversity strata currently supports a single viable population as defined by the TRT's viability criteria, although all occupied.

The SONCC coho salmon ESU is currently considered likely to become endangered. Of particular concern is the low number of adults counted entering the Shasta River in 2014-15. The lack of increasing abundance trends across the ESU for the populations with adequate data are of concern. Moreover, the loss of population spatial scale estimates from coastal Oregon populations is of great concern. The new information available since the 2011, while cause for concern, does not appear to suggest a change in extinction risk at this time.

2.2.2.2 CC Chinook Salmon

The following summary is from Williams et al. 2016, the most recent biological viability report for CC Chinook salmon.

The lack of long-term population-level estimates of abundance for Chinook salmon populations continues to hinder assessment of status, though the situation has improved with implementation of the CMP in the Mendocino Coast Region and portions of Humboldt County. The available data, a mixture of short-term (6-year or less) population estimates or expanded redd estimates and longer-term partial population estimates and spawner/redd indexes, provide no indication that any of the independent populations (likely to persist in isolation) are approaching viability targets. In addition, there remains high uncertainty regarding key populations, including the Upper and Lower Eel River populations and the Mad River population, due to incomplete monitoring across the spawning habitat of Chinook salmon in these basins (O'Farrell et al. 2012). Because of the short duration of most time series for independent populations, little can be concluded from trend information. The longest time series, video counts in the Russian River, indicates the population has remained steady during the 14-year period of record. The longer time series associated with index reaches or partial populations suggest mixed patterns, with some showing significant negative trends (Prairie Creek, Freshwater Creek, Tomki Creek), one showing a significant positive trend (Van Arsdale Station), and the remainder no significant trends.

At the ESU level, the loss of the spring-run life history type represents a significant loss of diversity within the ESU, as has been noted in previous status reviews (Good et al. 2005, Williams et al. 2011). Concern remains about the extremely low numbers of Chinook salmon in most populations of the North-Central Coast and Central Coast strata, which diminishes connectivity across the ESU. However, the fact that Chinook salmon have regularly been reported in the Ten Mile, Noyo, Big, Navarro, and Garcia rivers represents a significant improvement in our understanding of the status of these populations in watersheds where they were thought to have been extirpated. These observations suggest that spatial gaps between extant populations are not as extensive as previously believed.

In summary, Williams et al. (2016) concludes "there is a lack of compelling evidence to suggest that the status of these populations has improved or deteriorated appreciably since the previous status review" and that "the new available information does not appear to suggest there has been a change in the extinction risk of this ESU."

2.2.2.3 NC Steelhead

The following summary is from Williams et al. 2016, the most recent biological viability report for NC steelhead.

The availability of information on steelhead populations in the NC Steelhead DPS has improved considerably in the past 5 years, due to implementation of the CMP across a significant portion of the DPS. Nevertheless, significant information gaps remain, particularly in the Lower Interior and North Mountain Interior diversity strata, where there is very little information from which to assess status. Overall, the available data for winter-run populations—predominately in the North Coastal, North-Central Coastal, and Central Coastal strata— indicate that all populations are well below viability targets, most being between 5% and 13% of these goals…for the two Mendocino Coast populations with the longest time series, Pudding Creek and Noyo River, the 13-year trends have been negative and neutral, respectively (Williams et al. 2016). However, the short-term (6-year) trend has been generally positive for all independent populations in the North-Central Coastal and Central Coastal strata, including the Noyo River and Pudding Creek (Williams et al. 2016). Data from Van Arsdale Station likewise suggests that, although the long-term trend has been negative, run sizes of natural-origin steelhead have stabilized or are increasing (Williams et al. 2016). Thus, we have no strong evidence to indicate conditions for winter-run have worsened appreciably since the last status review.

Summer-run populations continue to be of significant concern because of how few populations currently exist. The Middle Fork Eel River population has remained remarkably stable for nearly five decades and is closer to its viability target than any other population in the DPS (Williams et al. 2016). Although the time series is short, the Van Duzen River appears to be supporting a population numbering in the low hundreds. However, the Redwood Creek and Mattole River populations appear small, and little is known about other populations including the Mad River and other tributaries of the Eel River (i.e., Larabee Creek, North Fork Eel, and South Fork Eel).

In summary, the available information for winter-run and summer-run populations of NC steelhead do not suggest an appreciable increase or decrease in extinction risk since publication of the last status reviews…most populations for which there are population estimates available remain well below viability targets; however, the short-term increases observed for many populations, despite the occurrence of a prolonged drought in northern California, suggests this DPS is not at immediate risk of extinction.

2.2.3 Factors for Decline (ESU or DPS Scale)

2.2.3.1 Timber Harvest

Timber harvest and associated activities occur over a large portion of the range of the affected species. Timber harvest has caused widespread increases in sediment delivery to channels through both increased landsliding and surface erosion from harvest units and log decks. Much of the largest riparian vegetation has been removed, reducing future sources of large woody debris (LWD) needed to form and maintain stream habitat that salmonids depend on during various life stages. In the smaller streams, recruited wood does not usually wash away, so logs

remain in place and act as check-dams that store sediment eroded from hillsides (Reid 1998). Sediment storage in smaller streams can persist for decades (Nakamura and Swanson 1993).
In fish-bearing streams, LWD originating from mature coniferous forests is important for storing sediment, halting debris flows, and decreasing downstream flood peaks, and its role as a habitat element becomes directly relevant for Pacific salmon species (Reid 1998). LWD alters the longitudinal profile and reduces the local gradient of the channel, especially when log dams create slack pools above or plunge pools below them, or when they are sites of sediment accumulation (Swanston 1991).

Cumulatively, the increased sediment delivery and reduced LWD supply have led to widespread impacts on stream habitats and salmonids. These impacts include reduced spawning habitat quality, loss of pool habitat for adult holding and juvenile rearing, loss of velocity refugia, and increases in the levels and duration of turbidity that reduce the ability of juvenile fish to feed (Reid 1998). These changes in habitat have led to widespread decreases in the carrying capacity of streams that support salmonids.

2.2.3.2 Road Construction

Road construction, whether associated with timber harvest or other activities, has caused widespread impacts on salmonids (Furniss et al. 1991). Where roads cross salmonid-bearing streams, improperly placed culverts have blocked access to many stream reaches. Land sliding and chronic surface erosion from road surfaces are large sources of sediment across the affected species' ranges. Roads also have the potential to increase peak flows and reduce summer base flows with consequent effects on the stability of stream substrates and banks. Roads have led to widespread impacts on salmonids by increasing the sediment loads. The consequent impacts on habitat include reductions in spawning, rearing, and holding habitat, and increases in turbidity. The delivery of sediment to streams can be generally considered as either chronic, or episodic. Chronic delivery refers to surface erosion that occurs from rain splash and overland flow. More episodic delivery, on the order of every few years, occurs in the form of mass wasting events, or landslides, that deliver large volumes of sediment during large storm events.

Construction of road networks can also greatly accelerate erosion rates within a watershed (Haupt 1959; Swanson and Dyrness 1975; Swanston and Swanson 1976; Reid and Dunne 1984; Hagans and Weaver 1987). Once constructed, existing road networks are a chronic source of sediment to streams (Swanston 1991) and are generally considered the main cause of accelerated surface erosion in forests across the western United States (Harr and Nichols 1993). Processes initiated or affected by roads include landslides, surface erosion, secondary surface erosion (landslide scars exposed to rain splash), and gullying. Roads and related ditch networks are often connected to streams via surface flow paths, providing a direct conduit for sediment. Where roads and ditches are maintained periodically by blading, the amount of sediment delivered continuously to streams may temporarily increase as bare soil is exposed and ditch roughness features, which store and route sediment and armor the ditch, are removed. Hagans and Weaver (1987) found that fluvial hillslope erosion associated with roads in the lower portions of the Redwood Creek watershed produced about as much sediment as landslide erosion between 1954 and 1980. In the Mattole River watershed, the Mattole Salmon Group (1997) found that roads, including logging haul roads and skid trails, were the source of 76 percent of all erosion problems mapped in the watershed. This does suggest that, overall, roads are a primary source of sediment in managed watersheds.

Road surface erosion is particularly affected by traffic, which increases sediment yields substantially (Reid and Dunne 1984). Other important factors that affect road surface erosion include condition of the road surface, timing of when the roads are used in relation to rainfall, road prism moisture content, location of the road relative to watercourses, methods used to construct the road, and steepness on which the road is located.

2.2.3.3 Hatcheries

Releasing large numbers of hatchery fish can pose a threat to wild salmon and steelhead stocks through genetic impacts, competition for food and other resources, predation of hatchery fish and wild fish, and increased fishing pressure on wild stocks as a result of hatchery production (Waples 1991). The genetic impacts of artificial propagation programs are primarily caused by the straying of hatchery fish and the subsequent hybridization of hatchery and wild fish. Artificial propagation threatens the genetic integrity and diversity that protects overall productivity against changes in environment (Waples 1991). The potential adverse impacts of artificial propagation programs are well-documented (Waples 1991; Waples 1999; National Research Council 1995).

2.2.3.4 Water Diversions and Habitat Blockages

Water diversions are common throughout the species' ranges. Unscreened diversions for agricultural, domestic, and industrial uses are a significant factor for salmonid declines in many basins. Reduced stream-flows due to diversions reduce the amount of habitat available to salmonids and can degrade water quality, such as causing elevated water temperatures. Reductions in water quantity can reduce the carrying capacity of the affected stream reach by reducing the amount of available habitat, including by causing discontinuous flow and subsequent disconnected pools. Where warm return flows enter the stream, fish may seek reaches with cooler water, thus increasing competitive pressures in these areas.

Habitat blockages have occurred in relation to road construction as discussed previously. In addition, hydropower, flood control, and water supply dams of different municipal and private entities, have permanently blocked or hindered salmonid access to historical spawning and rearing grounds. The percentage of habitat blocked by dams is likely greatest for steelhead because steelhead were more extensively distributed upstream than Chinook or coho salmon. Because of migration barriers, salmon and steelhead populations have been confined to lower elevation mainstems that historically only were used for migration and rearing. Population abundances have declined in many streams due to decreased quantity, quality, and spatial distribution of spawning and rearing habitat (Lindley et al. 2007).

2.2.3.5 Predation

Predation likely did not play a major role in the decline of salmon populations; however, it may have substantial impacts at local levels. For example, Higgins et al. (1992) and CDFG (1994) reported that Sacramento pikeminnow (*Ptychocheilus grandis*) accidentally introduced to the Eel River basin are a major competitor and predator of the native salmonids found there.

2.2.3.6 Disease

Disease has not been identified as a major factor in the decline of ESA-listed salmonids. However, disease may have substantial impacts in some areas and may limit recovery of local salmon populations. Although naturally occurring, many of the disease issues salmon and steelhead currently face have been exacerbated by human-induced environmental factors such as water regulation (damming and diverting) and habitat alteration. Natural populations of salmonids have co-evolved with pathogens that are endemic to the areas salmonids inhabit and have developed levels of resistance to them. In general, diseases do not cause significant mortality in native salmonid stocks in natural habitats (Bryant 1994, Shapovalov and Taft 1954). However, when this natural habitat is altered or degraded, outbreaks can occur. For example, ceratomyxosis, which is caused by *Ceratonova shasta*, has been identified as one of the most significant diseases for juvenile salmon in the Klamath Basin due to its prevalence and impacts there (Nichols et al. 2007) that are related to reduced flows and increased water temperatures. Ceratomyxosis disease outbreaks occur most years on the Klamath River and may be more prevalent under drought conditions (e.g., 2021).

2.2.3.7 Commercial and Recreational Fisheries

Salmon and steelhead once supported extensive tribal, commercial, and recreational fisheries. NMFS has identified over-utilization as a significant factor in their decline. This harvest strongly affected salmonid populations because, each year, it removed adult fish from the ESU before they spawned, reducing the numbers of offspring in the next generation. In modern times, steelhead are rarely caught in ocean salmon fisheries. Directed and incidental take of Chinook and coho salmon in ocean fisheries are currently managed by NMFS to achieve Federal conservation goals for west coast salmon in the Pacific Coast Salmon Fishery Management Plan (FMP). The goals specify the numbers of adults that must be allowed to spawn annually, or maximum allowable adult harvest rates. In addition to the FMP goals, salmon fisheries must meet requirements developed through NMFS' intra-agency section 7 consultations, including limiting the incidental mortality rate of ESA-listed salmonids.

2.2.3.8 Climate Change

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

The threat to listed salmonids from global climate change will increase in the future. Modeling of climate change impacts in California suggests that average summer air temperatures are expected to continue to increase (Lindley et al. 2007, Moser et al. 2012). Heat waves are expected to occur more often, and heat wave temperatures are likely to be higher (Hayhoe et al. 2004, Moser et al. 2012. Kadir et al. 2013). Total precipitation in California may decline; critically dry years may increase (Lindley et al. 2007, Schneider 2007, and Moser et al. 2012). Wildfires are expected to increase in frequency and magnitude (Westerling et al. 2011, Moser et al. 2012). Catastrophic wildfires in 2018, 2019, and 2020, coupled with severe drought in California seemingly verify the modeling of potential impacts as a result of global climate change.

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

2.2.3.9 Ocean Conditions

Variability in ocean productivity affects fisheries production both positively and negatively (Chavez et al. 2003). Beamish and Bouillion (1993) showed a strong correlation between North Pacific salmon production and marine environmental factors from 1925 to 1989. Beamish et al. (1997a) noted decadal-scale changes in the production of Fraser River sockeye salmon that they attributed to changes in the productivity of the marine environment. Warm ocean regimes are characterized by lower ocean productivity (Behrenfeld et al. 2006, Wells et al. 2006), which may affect salmon by limiting the availability of nutrients regulating the food supply, thereby increasing competition for food (Beamish and Mahnken 2001). Data from across the range of coho salmon on the coast of California and Oregon reveal there was a 72 percent decline in returning adults in 2007/08 compared to the same cohort in 2004/05 (MacFarlane et al. 2008).

The Wells Ocean Productivity Index, an accurate measure of Central California ocean productivity, revealed poor conditions during the spring and summer of 2006, when juvenile coho salmon and Chinook salmon from the 2004/05 spawn entered the ocean (McFarlane et al. 2008). Data gathered by NMFS suggests that strong upwelling in the spring of 2007 may have resulted in better ocean conditions for the 2007 coho salmon cohort (MacFarlane et al. 2008). The quick response of salmonid populations to changes in ocean conditions (MacFarlane et al. 2008) strongly suggests that density dependent mortality of salmonids is a mechanism at work in the ocean (Beamish et al. 1997b, Levin et al. 2001, Greene and Beechie 2004).

The poor conditions reflect warmer than average sea surface and deep-sea temperatures associated with a relative lack of lipid-rich species of zooplankton, and krill biomass that was the lowest in the last 20 years (Peterson et al. 2015). These warm ocean conditions are attributed to a strengthening El Niños in addition to anomalously warm conditions (the "warm blob") that began in 2013 (Peterson et al. 2015) and continued through 2019.

The smolt to adult return rate for coho salmon at Freshwater Creek, a tributary of Humboldt Bay in Northern California, was less than 3 percent from 2011 to 2013 (Anderson et al. 2015). Bradford et al. (2000) found that the average coastal coho salmon population would be unable to sustain itself when marine survival rates fall below about 3 percent. Ocean conditions are not necessarily the only influence of marine survival; however, if marine survival is below 3 percent, the SONCC coho salmon ESU will have difficulty sustaining itself. Therefore, poor ocean conditions and low marine survival poses a key threat to the SONCC coho salmon ESU. This is likely the case for other ESUs and DPSs that use the California Current.

2.2.3.10 Drought

The following language is taken from Williams et al. 2016, which provides a description of the effects of recent drought conditions on listed salmonids in California, but has been updated to include those similar conditions that have occurred since 2016.

California has experienced well below average precipitation over the last decade (2010-2020). Some paleoclimate reconstructions suggest that the current drought is the most extreme in the past 500 or perhaps more than 1000 years. Anomalously high surface temperatures have amplified the effects of drought on water availability This period 2010-2020 of drought and high air, stream, and upper-ocean temperatures have together likely had negative impacts on the freshwater, estuary, and marine phases for many populations of Chinook salmon, coho salmon, and steelhead.

2.2.3.11 Marine-Derived Nutrients

Marine-derived nutrients (MDN) are nutrients that are accumulated in the biomass of salmonids while they are in the ocean and are then transferred to their freshwater spawning sites where the salmon die. The return of salmonids to rivers makes a significant contribution to the flora and fauna of both terrestrial and riverine ecosystems (Gresh et al. 2000), and has been shown to be vital for the growth of juvenile salmonids (Bilby et al. 1996, 1998). Evidence of the role of MDN and energy in ecosystems suggests a deficit of MDN may result in an ecosystem failure contributing to the downward spiral of salmonid abundance (Bilby et al. 1996). Reduction of MDN to watersheds is a consequence of the past century of decline in salmon abundance (Gresh et al. 2000).

2.2.4 Critical Habitat

NMFS is responsible for designating critical habitat for species listed under its jurisdiction. In designating critical habitat, NMFS considers the following requirements of the species: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, or rearing offspring; and, generally, (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of this species (see 50 CFR 424.12(b)). In addition to these factors, NMFS focuses on the known PBFs within the designated area that are essential to the conservation of the species and that may require special management considerations or protection. Designated critical habitat for all the species listed below overlaps with the action area.

2.2.4.1 SONCC Coho Salmon Critical Habitat

Description
Designated critical habitat for SONCC coho salmon encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between the Mattole River in California and the Elk River in Oregon, inclusive (May 5, 1999, 64 FR 24049). Excluded are: (1) areas above specific dams identified in the Federal Register notice; (2) areas above longstanding natural impassible barriers (i.e., natural waterfalls); and (3) tribal lands. The area described in the final rule represented the current freshwater and estuarine range of coho salmon. Land ownership patterns within the coho salmon ESU analyzed in this document and spanning southern Oregon and northern California are 53% private lands, 36% Federal lands, 10% State and local lands, and 1% tribal lands.

The designated critical habitat for SONCC coho salmon is separated into the five PBFs of the species' life cycle. The five PBFs (essential habitat types) include: (1) juvenile summer and winter rearing areas; (2) juvenile migration corridors; (3) areas for growth and development to adulthood; (4) adult migration corridors; and (5) spawning areas. Within these areas, PBFs (essential features) of SONCC coho salmon critical habitat include adequate: (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions (64 FR 24049; May 5, 1999).

Current Condition
The condition of SONCC coho salmon critical habitat at the ESU scale, specifically its ability to provide for the species' conservation, has been degraded from conditions known to support viable salmonid populations that contribute to survival and recovery of the species. NMFS determined that present depressed population conditions are, in part, the result of human-induced factors affecting critical habitat, including: intensive timber harvesting, agricultural and mining activities, urbanization, stream channelization, dams, wetland loss, and water withdrawals for irrigation. All of these factors were identified when SONCC coho salmon were listed as threatened under the ESA, and they continue to affect this ESU (NMFS 2014) and designated critical habitat. However, efforts to improve coho salmon critical habitat have been widespread and are expected to benefit the ESU over time (NMFS 2014).

Within the SONCC coho salmon critical habitat, a large number of habitat restoration actions have been implemented including reducing sediment, creating backwater channels and ponds for juvenile rearing, increasing flows and screening diversions, adding LWD, and fixing fish passage impediments. Therefore, the condition of SONCC coho salmon critical habitat is improved in localized areas where restoration has occurred, but larger scale quality remains impaired.

SONCC coho salmon are dependent upon complex, low gradient habitats for winter rearing, and will express diversity by overwintering in low-gradient, off-channel and estuarine habitats when they are available. The lack of complex aquatic habitat, and much decreased access to floodplains and low gradient tributaries are common features of current critical habitat conditions within the SONCC coho salmon ESU (NMFS 2014). The Recovery Plan also describes that land use activities (e.g., timber harvest, road building, etc.) that occur upstream of low gradient streams, still affect the habitat within low gradient streams by reducing the amount of large wood and shade available and by increasing the amount of sediment that routes through the valley bottom habitats.

2.2.4.2 CC Chinook Salmon Critical Habitat

Description

Designated critical habitat for CC Chinook salmon includes the stream channels up to the ordinary high-water line (50 CFR Part 226.211). In areas where the ordinary high-water line has not been defined pursuant to 50 CFR Part 226.211, the lateral extent is defined by the bankfull elevation. Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater.

Critical habitat for CC Chinook salmon was designated as occupied watersheds from the Redwood Creek watershed, south to and including the Russian River watershed (70 FR 52488, September 2, 2005). Humboldt Bay and the Eel River estuary are designated as critical habitat for the CC Chinook Salmon ESU. Some areas within the geographic range were excluded due to economic considerations. Critical habitat was not designated on Indian lands. Designated critical habitat for CC Chinook salmon overlaps the action area. In designating critical habitat for CC Chinook salmon, NMFS focused on areas that are important for the species' overall conservation by protecting quality growth, reproduction, and feeding. The critical habitat designation for these species identifies the known PBFs that are necessary to support one or more Chinook salmon life stages, including: (1) freshwater spawning, (2) freshwater rearing, (3) freshwater migration, (4) estuarine areas, (5) nearshore marine areas, and (6) offshore marine areas. Within the PBFs, essential elements of CC Chinook salmon critical habitats include adequate (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, (10) safe passage conditions, and (11) salinity conditions (70 FR 52488, September 2, 2005).

Current Condition

The condition of CC Chinook salmon critical habitat, specifically its ability to provide for their conservation, is degraded from conditions known to support viable salmonid populations. NMFS has determined that present depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat: logging, agricultural and mining activities, urbanization, stream channelization, dams, freshwater and estuarine wetland loss, and water withdrawals for irrigation. All of these factors were identified when CC Chinook salmon were listed as threatened under the ESA, and they all continue to affect this ESU. Therefore, the condition of CC Chinook salmon critical habitat is improved in localized areas where restoration has occurred, but larger scale quality remains impaired.

2.2.4.3 NC Steelhead Critical Habitat

Description
NMFS designated critical habitat for NC steelhead in September 2005 (70 FR 52488, September 2, 2005). Designated critical habitat for NC steelhead includes the stream channels up to the ordinary high-water line (50 CFR 226.211). In areas where the ordinary high-water line has not been defined pursuant to 50 CFR 226.211, the lateral extent is defined by the bankfull elevation. Critical habitat in estuaries is defined by the perimeter of the water body as displayed on standard 1:24,000 scale topographic maps or the elevation of extreme high water, whichever is greater. Critical habitat for NC steelhead was designated as occupied watersheds from the Redwood Creek watershed, south to and including the Gualala River watershed. Humboldt Bay and the Eel River estuary are designated as critical habitat for the NC Steelhead DPS. In general, the extent of critical habitat conforms to the known distribution of NC steelhead in streams, rivers, lagoons and estuaries (NMFS 2005). Some areas within the geographic range were excluded due to economic considerations. Native American lands and U.S. Department of Defense lands were also excluded.

Specific PBFs, that are essential for the conservation of each species, were identified as: freshwater spawning sites; freshwater rearing sites; freshwater migration corridors; estuarine areas; nearshore marine areas; and offshore marine areas. Within the PBFs, essential elements of NC steelhead critical habitats include adequate (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, (10) safe passage conditions, and (11) salinity conditions (70 FR 52488, September 2, 2005).

Designated critical habitat for NC steelhead overlaps the action area. In designating critical habitat for NC steelhead, NMFS focused on areas that are important for the species' overall conservation by protecting quality growth, reproduction, and feeding.

Current Condition
Similar to the current condition of SONCC coho salmon and CC Chinook salmon critical habitat, the current condition of NC steelhead critical habitat is degraded throughout most of the range of this species. Estuaries and lower river habitats are greatly reduced, in both area and condition, as the valley bottoms near the mouths of rivers are where most of the agricultural and urban development is concentrated. Levees constrain most estuaries and lower rivers in this DPS and prevent access to important off-channel rearing habitat. Upstream land uses increase the amount of sediment and warm water that enters low gradient streams and decreases the availability of large wood in these habitats.

The condition of NC steelhead critical habitat, specifically its ability to provide for their conservation, is degraded from conditions known to support viable salmonid populations. NMFS determined that present depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat: logging, agricultural and mining activities, urbanization, stream channelization, dams, freshwater and estuarine wetland loss, and water withdrawals for irrigation. All of these factors were identified when NC steelhead were listed as threatened under the ESA, and they all continue to affect this DPS. Therefore, the condition of

NC steelhead critical habitat is improved in localized areas where restoration has occurred, but larger scale quality remains impaired.

2.2.4.4 Eulachon Critical Habitat

NMFS designated critical habitat for the Southern DPS of eulachon on October 20, 2011 (76 FR 65323). In designating critical habitat for eulachon, NMFS focused on the lower portions and estuaries of 16 freshwater creeks and rivers in California, Oregon and Washington. These creeks and rivers included the southern extent as the Mad River in California to the Elwha River in Washington. The lower portion of the action area on the Mad River is within the designated critical habitat on the Mad River which extends from the mouth to13 river miles upstream to the confluence North Fork of the Mad River and includes those areas to the ordinary high water line or the bankfull elevation. Tribal lands are exempt from this designation.

Specific PBFs that are essential for the conservation of eulachon were identified as: freshwater spawning sites and freshwater migration corridors; estuarine areas; and nearshore marine areas. Within these PBFs, the essential elements for eulachon conservation include: (1) Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation; (2) Freshwater and estuarine migration corridors free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted; (3) Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival (76 FR 65323).

Current condition

Similar to the current condition of salmon and steelhead critical habitat, the current condition of eulachon critical habitat is degraded throughout most of the range of this species. Estuaries and lower river habitats are greatly reduced, in both area and condition, as the valley bottoms near the mouths of rivers are where most of the agricultural and urban development is concentrated. Upstream land uses increase the amount of sediment and warm water that enters low gradient streams. Most importantly, climate change and associated increased ocean and freshwater temperatures is compromising the ability of the habitat to support eulachon.

The condition of eulachon critical habitat, specifically its ability to provide for their conservation, is degraded from conditions known to support viable populations. NMFS determined that present depressed population conditions are, in part, the result of human-induced factors affecting critical habitat including: climate change: logging, agricultural and mining activities, urbanization, stream channelization, dams, freshwater and estuarine wetland loss, and water withdrawals for irrigation. Therefore, the condition of eulachon critical habitat is improved in localized areas where restoration has occurred, but larger scale quality remains impaired, primarily as a result of anthropogenic climate change.

2.2.4.5 Conservation Value of Critical Habitat for SONCC Coho Salmon, NC Steelhead, and CC Chinook Salmon

The PBFs of designated critical habitat for SONCC coho salmon, NC steelhead, and CC Chinook salmon are those accessible freshwater habitat areas that support spawning, incubation and rearing, migratory corridors free of obstruction or excessive predation, and estuarine areas with good water quality and that are free of excessive predation. Timber harvest and associated activities, road construction, urbanization and increased impervious surfaces, migration barriers, water diversions, and large dams throughout a large portion of the freshwater range of the ESUs and DPSs continue to result in habitat degradation, reduction of spawning and rearing habitats, and reduction of stream flows. The result of these continuing land management practices in many locations has limited reproductive success, reduced rearing habitat quality and quantity, and caused migration barriers to both juveniles and adults. These factors likely limit the conservation value (i.e., limiting the numbers of salmonids that can be supported) of designated critical habitat within freshwater habitats at the ESU/DPS scale.

Although watershed restoration activities have improved freshwater critical habitat conditions in isolated areas, reduced habitat complexity, poor water quality, and reduced habitat availability continue because the same land management practices persist in many locations. The degraded conditions of critical habitats highlight the increased conservation value of remaining semi-functional to functional PBFs of critical habitat.

2.2.4.5 Conservation Value of Eulachon Critical Habitat

The current conservation value of critical habitat is degraded, primarily as a result of anthropogenic climate change and past decreases in estuary size and function, as well as impacts to migration corridors and freshwater spawning and incubation areas. This highlights the importance of functional eulachon critical habitat to the conservation of the eulachon DPS.

2.2.4.5 Summary

Although watershed restoration activities have improved freshwater and estuarine critical habitat conditions in isolated areas, reduced habitat complexity, poor water quality, and reduced habitat availability that resulted from historical and ongoing land management practices persist in many locations, and are limiting the conservation value of designated critical habitat within these freshwater and estuarine habitats at the ESU and DPS scales. Nevertheless, the critical habitats for these species provide important PBFs for these species to survive and recover. The degraded conditions of critical habitats highlight the increased conservation value of remaining semi-functional to functional PBFs of critical habitat.

Eulachon critical habitat in freshwater is likely not the limiting factor for eulachon populations, except where climate change influences winter water temperatures or reductions in estuary size and function has been degraded. Similarly, climate change is likely the primary factor influencing near-shore marine areas including ocean productivity and water temperatures. Nevertheless, eulachon critical habitat provides important PBFs for eulachon to survive and recover. The degraded condition of eulachon critical habitat highlights the increased conservation value of remaining semi-functional to functional PBFs of eulachon critical habitat.

2.3. Action Area

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

The action area for the proposed action includes two locations. The downstream action area includes the Mad River in the Essex reach (approximately RM 9) near Arcata, California from the uppermost Ranney collector to approximately 1,500 feet downstream of the weir at Station 6. The downstream extent is where any sediment generated from the Project is expected to create turbidity or be deposited. The upstream action area (RM 84) is near the town of Ruth, California. The upstream action area includes the Mad River from the base of Matthews Dam to a point approximately 1,500 feet downstream where any sediment generated from the Project is expected to create turbidity or be deposited.

2.4. Environmental Baseline

The "environmental baseline" refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultations, and the impact of State or private actions which are contemporaneous with the consultation in process. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

2.4.1 Status of Listed Species in the Action Area

The Mad River is part of the Central Coast diversity stratum for SONCC coho salmon, and the North Coastal diversity stratum for CC Chinook salmon and NC winter steelhead (Spence et al. 2008, Williams et al. 2008). In addition, the Mad River is part of the Northern Coastal/North Mountain Interior diversity stratum for NC summer steelhead. For coho salmon, CC Chinook salmon, and NC steelhead, the Mad River is identified as an area that should ultimately support a viable population (one at low risk of extinction) because these populations are expected to play a key role in recovery of the ESU or DPS. In order for an ESU or DPS to be viable and eligible for delisting, all diversity strata that make up that ESU or DPS must be viable (Spence et al. 2008, Williams et al. 2008). Given the current expected roles of each population in recovery, the Mad River must support a viable population in order for the Central Coastal and Northern Coastal diversity strata of coho salmon and Chinook salmon and NC steelhead, respectively, to be viable. Table 1 provides a summary of the status of coho salmon, Chinook salmon, and steelhead in the downstream action area.

The Mad River is the southern-most extent of the Southern DPS of eulachon. At this point, eulachon are likely at extremely low levels and it is unclear if spawning occurs each year. However, there is currently only very limited or no surveys occurring on the Mad River that would be likely to catch or observe eulachon.

Table 1. Status of the three ESA-listed salmonid species' populations found within the action area as outlined in each species recovery plans.

	SONCC Coho Salmon	CC Chinook Salmon Fall-Run	NC Steelhead (Winter-Run)	NC Steelhead (Summer-run)
Population within the Action Area	Mad River	Mad River	Mad River	Mad River
Diversity Stratum	Central Coastal	North Coastal	North Coastal/North Mountain Interior	North Coastal/North Mountain Interior
Role within ESU/DPS	Functionally Independent	Functionally Independent	Functionally Independent	Functionally Independent
Extinction Risk	High	Low*	Low*	High*
Depensation Threshold	Likely below	Above*	Above*	Below*
Spawner Abundance Target	9,300 adults	3,000 adults	Lower Mad River=3,200 adults Upper Mad River=6,100 adults	Effective populations size N_e>=500
Watershed Size/Potential Habitat	494 square miles 135 IP-km	494 Square miles 94 IP-km	494 Square miles Lower Mad River= 146 IP-km; Upper Mad River= 304 IP-km	494 Square miles Lower Mad River= 146 IP-km; Upper Mad River= 304 IP-km
Limiting Stresses	Altered Sediment Supply; Lack of Floodplain and Channel Structure	Estuary: Quality and Extent; Water Quality: Turbidity; Habitat Complexity: Large Wood, Shelter and Pools	Water Quality: Temperature and turbidity; Riparian Vegetation: Canopy Cover and Tree Diameter; Habitat Complexity: Large Wood	Water Quality: Temperature and turbidity; Riparian Vegetation: Canopy Cover and Tree Diameter; Habitat Complexity: Large Wood
Limiting Threats	Roads, Mining/gravel extraction	Channel Modification; roads	Channel Modification; Logging and Wood harvesting; Roads	Channel Modification; Logging and Wood harvesting; Roads

*The Multispecies Recovery Plan did not assign extinction risk categories or address depensation levels, so professional judgement was used to assign these categories to be consistent with the SONCC Coho Salmon Recovery Plan.

Actual population estimates for coho salmon, summer-and winter- steelhead, and Chinook salmon are limited to what has been collected in recent years. CDFW has been operating sonar and apportioning results to species in the Lower Mad River since 2013 using an ARIS (Adaptive Resolution Imaging Sonar) system. From August 28, 2017 to January 2, 2018, the abundance estimate for adult coho salmon was 1,575 (95% CI = 1,482 – 1,668; CV = 3.0%) (Sparkman and Holt 2020). The Mad River estimate of adult CC Chinook salmon populations using sonar for the years 2014-2018 ranged from 4,100 to 9,606 (Sparkman and Holt 2020). The number of adult winter steelhead (natural and hatchery-origin) detected per year ranged from 712 to 7,761 between fall 2014 and winter of 2018. The number of adult summer steelhead from 2014-2018 ranged between 191 and 558 (Sparkman and Holt 2020). The CDFW also differentiated fall steelhead from either summer steelhead or winter steelhead, which reduces the summer-and winter-run estimates.

The upstream portion of the action area likely does not have any listed species that reach the area because of a series of natural barriers that limit upstream migration. However, this area is currently designated critical habitat for CC Chinook salmon, SONCC coho salmon, and NC steelhead.

2.4.2 Overview of the Mad River Watershed

The Mad River is designated critical habitat for SONCC coho salmon, CC Chinook salmon, NC steelhead, and eulachon. The key limiting stresses for each salmon and steelhead species are identified above in Table 1. Where these stresses influence water quality (sediment and temperature) they would also affect eulachon freshwater productivity. Timber harvest, road building, gravel mining, grazing and water diversion/impoundment are the land and water uses that have had the most pronounced effect on salmon and steelhead habitat in the Mad River basin. Much of the North Fork watershed and the lower and middle portions of the Mad River basin are owned by Green Diamond Resource Company (GDRC) and are used for timber production. Grazing occurs on large ranches throughout the Mad River basin, as well as more concentrated grazing along the reaches of the lower river and its tributaries. Most of the upper basin is part of the Six Rivers National Forest and is managed using an ecosystem-based approach that provides for resource protection under the Northwest Forest Plan (Forest Ecosystem Management Assessment Team 1993). Water quality (sediment and temperature) in the downstream action area may be affected by these activities.

The HBMWD constructed Matthews Dam in 1961 at river mile (RM) 84 in the upper basin, which created Ruth Reservoir, well upstream of historic coho salmon and Chinook salmon habitat, but it did block some steelhead habitat. The reservoir is used by HBMWD to store storm flows for release down the river and withdrawal near the Essex facility in Arcata, California for municipal and industrial use. The withdrawals are accomplished using Ranney wells approximately 50 feet below the river bottom and from a screened surface water diversion. The release of water from Ruth Reservoir provides a higher summer low flow than what occurred prior to dam construction because HBMWD needs to deliver water downstream for diversion at the Essex facility. The HBMWD operations primarily impact flows during the fall and early winter when they begin capturing flows from the first storm events in the watershed above Ruth Reservoir. These lower flows may have some influence on Chinook salmon migration timing during some years when this decreased flow would result in impaired adult migration cues or reduce the depth of water for migration in the action area. Additionally, during some years, the flow recession in the spring may result in lower flows during a short period of time when mandated river flows are less than what the natural flows would be, which may influence Chinook salmon smolt outmigration timing.

Extensive instream gravel mining occurs throughout the lower Mad River; mining practices have greatly improved since the 1970s. The majority of large gravel bars on the lower mainstem Mad River between Blue Lake and Highway 299 are mined each year, and annual mining typically removes the estimated mean annual recruitment of gravel coming into the mining reach. Since gravel extraction is the focus of this Opinion, more information will be provided below.

The communities of Arcata, Blue Lake, and McKinleyville are located along the lowermost reach of the Mad River, near the mouth. Many of the impacts of urbanization are in the form of development and associated road construction and land clearing, resulting in increased run-off, increased fine sediment, increased chemical contamination from run-off of roads and other surfaces, intrusion into the Mad River floodplain with development (*e.g.*, roads, bridges, houses, and other infrastructure) that reduces the floodplain, water diversions from tributaries for agriculture and domestic uses, and establishment of homeless encampments.

The land uses described above have reduced available salmon and steelhead habitat throughout the basin. Increased sediment production from logged hill slopes and roads, especially as occurred during the 1955 and 1964 flood events, have filled the Mad River with sediment, creating chronically high turbidity levels. Although the Mad River basin has naturally high rates of sediment delivery due to unstable hill slopes prone to landslides and high rates of surface erosion, the U.S. Environmental Protection Agency (USEPA) estimated that 64 percent of total sediment delivered to streams was attributed to human and land management related activities, with roads being the dominant sediment source (USEPA 2007). In the lower Mad River and North Fork areas, total sediment loading was five times greater than natural sediment loading (USEPA 2007), and likely remains significantly higher than natural.

Compounding the increase in sediment delivery, loss of riparian vegetation has reduced shading and created a lack of instream large wood. These land uses have resulted in warm, shallow and wide instream habitat conditions that have severely impacted salmonids. Most of the basin now has forest stands of smaller diameter trees, with a greater percentage of hardwoods that provide different ecological functions than those found historically (GDRC 2006). This affects water quality (sediment and temperature) and recruitment of LWD in the action area.

Water impoundment and release for municipal diversion and hydroelectric operations has resulted in greater than naturally occurring summer flows in the action area, potentially increasing habitat availability during summer and early fall months. Screened water diversions at Essex in the lower river create minor fluctuations in the rate of flows in the summer and early fall. The impacts of this diversion are negligible in most instances. However, peak flows in the fall are dampened and this may make adult migration more difficult or may dampen the flow cues salmonids use for upstream migration.

The Mad River is listed as "Impaired" for sediment and temperature under section 303(d) of the Clean Water Act (USEPA 2007). NMFS (2014) describes stresses to the Mad River salmonid populations as: lack of floodplain and channel structure, impaired water quality, altered sediment supply, degraded riparian conditions, and altered hydrologic function. Salmonid habitat in the Mad River is generally degraded. There is excessive sediment supply coming from roads and other land disturbances, which fills pools and interferes with spawning success. Suitable instream structure, as well as off-channel habitat, is extremely limited. These habitat features are essential to rearing juveniles. Insufficient riparian cover means there is not enough large wood falling into the stream to create this structure. Degraded riparian condition also leads to impaired water temperatures due to a lack of shade. Water temperatures in the lethal to stressful range have been observed Mad River (NMFS 2014). Tributary stream flows have been adversely affected by diversion of streams and springs for rural domestic and marijuana farming (NMFS 2014).

2.4.3 Factors affecting species environment within the action area

The key limiting threats, those that most affect the viability of the population by influencing stresses, are roads and mining/gravel extraction, and timber harvest. Several other threats with somewhat lower potential to affect survival and recovery are also present in the action area, as summarized below.

Roads

Road density is very high throughout the basin, ranging from 4.4 to 6.3 miles of road per square mile in the lower Mad River and North Fork areas (USEPA 2007). Roads are a substantial source of both chronic and catastrophic sediment input to streams in the basin, affecting the quality and quantity of available salmon and steelhead habitat in the Mad River and its tributaries, including the action area. In 2007, the USEPA developed the TMDL for sediment and turbidity for the Mad River (USEPA 2007). An estimated 64 percent of the total sediment delivered to streams was attributed to human and land management-related activities, and road-related sediment contributes approximately 62 to 73 percent of the anthropogenic sediment in the basin (USEPA 2007). Additionally, roads and associated infrastructure can impinge on the floodplains, which reduces availability for salmonids and riparian development.

Mining/Gravel Extraction

Historic gravel extraction was very damaging to the habitat in the lower Mad River, including the action area. In response to habitat concerns, Humboldt County initiated the County of Humboldt Extraction Review Team (CHERT) in 1994. Current instream mining practices are much improved over past practices and extraction volumes have been significantly reduced. However, even with minimization measures, gravel extraction may reduce overall habitat complexity, but the magnitude of this effect is highly variable depending on the location, type, and volume of the extraction. Additionally, some appropriately placed and sized extractions (e.g., alcoves) have provided short-term enhancement of habitat complexity and value.

Given the sensitivity of the channel to disturbance caused by extractions, and the use of the gravel extraction reach by salmon and steelhead, gravel extraction is a high threat to salmon and steelhead in the Mad River as described in the recovery plans for Chinook salmon, steelhead, and coho salmon (NMFS 2014, 2016). However, there is a recent trend in the recovery of habitat in the mining reach that may be attributed to some extraction techniques (Stillwater Sciences 2020) including increased riparian growth that has resulted from implementation of floodplain extractions, reducing skimming and skim widths, short-term improvements from alcove extractions, varying the annual extraction volume based on estimated gravel recruitment in the extraction volume, and a reduction in the annual volume extracted.

Channelization/Diking

Channelization and diking presents a high threat to the Mad River population. Levees confine some the Mad River in the action area and disconnect the channel from its floodplain and wetlands, reducing the availability of off-channel winter rearing habitat and reducing the ability of the channel to meander and create new habitats.

Timber Harvest

Timber harvest is a medium to high threat to the salmon and steelhead populations in the Mad River. Many of the changes that have occurred to instream and riparian conditions in the basin reflect legacy effects of more intensive harvest from previous decades. Although current timber harvest practices are more protective of salmonid habitat than before, timber harvest likely threatens the persistence of the salmonid populations by increasing sediment yield and reducing streamside shading (and increasing water temperatures) and potential large wood recruitment. The majority of the private timberland in the Mad River basin is owned by Green Diamond and will continue to be harvested for timber. Within Green Diamond property, harvest occurs at a moderate level and under the direction of the company's Aquatic Habitat Conservation Plan (AHCP; GDRC 2006). This plan lays out goals and objectives to minimize and mitigate effects from timber harvest through measures related to road and riparian management, slope stability, and harvesting activities. Although the private timberland is managed under an AHCP that reduces the effects of timber harvest, increased sediment yield, decreased sources of instream wood, and decreased stream shading are still expected to occur and affect conditions in the action area by increasing fine sediment, increasing water temperature, and reducing LWD recruitment.

Dams/Diversions

Dams and diversions pose a substantial threat to the Mad River salmonid populations. Dams in the action area do not block much habitat for salmonids, but they do alter the Mad River hydrology. Diversions and groundwater pumping at the HBMWD Essex facility (RM 9 to 10) cause daily flow fluctuations during summer and fall months; however, observations by NMFS staff and analysis of gage data (NMFS 2005) show negligible impacts on juvenile salmonids, with water level generally dropping no more than 0.2 feet. Due to riffle grade control, it is unlikely that the amount of available habitat is decreased for rearing coho salmon and stranding has never been documented (HBMWD and Trinity Associates 2004). Changes in flows, however, may affect migration of adults during the fall. The impoundment of the Mad River at Matthews Dam has also increased summer and fall flows throughout most of the mainstem Mad River and increased habitat availability in the action area.

Agricultural Practices

Agricultural practices pose an overall medium threat to salmonids in the Mad River watershed, including the action area. Grazing occurs throughout the basin and may contribute to increased fine sediment and to decreased riparian vegetation which affects water quality in the action area. Other agriculture, such as the cultivation of hay and irrigation of pastures and dairy operations also occurs in the lower basin. Cannabis cultivation in the Mad River watershed may also affect water quality and quantity in the action area.

High Severity Fire

Altered vegetation characteristics throughout the basin pose a moderate threat to salmonids from high severity fires. Most of the basin contains forests of small diameter trees that are close together. These types of previously logged forests burn with greater intensity than late seral forest stands, and high severity forest fires create an erosion hazard. The increased sediment yield from high severity fires would likely deliver sediment to salmonid habitat in the basin, including the action area, filling pools and reducing habitat complexity. Riparian vegetation would also be reduced or eliminated, and issues associated with inadequate riparian cover, including increased water temperatures and decreased macroinvertebrate abundance in the watershed (including the action area) would be aggravated.

Climate Change
Climate change poses a threat to salmonid and eulachon populations in northern California. Although the current climate is generally cool, modeled regional average temperature shows a relatively large increase over the next 50 years (the period to which the model applies) (PRBO Conservation Science 2011). Average air temperature could increase by up to 2°C in the summer and by 1°C in winter. Annual precipitation in this area is predicted to change little over the next century. The vulnerability of the estuary and coast to sea level rise is moderate in this population. Juvenile and smolt rearing are most at risk due to increasing temperatures and changes in the amount and timing of precipitation, which will affect water quality and hydrologic function in the summer. However, some degree of protection for mainstem flows is provided by the flow augmentation from Matthews Dam. The range and degree of temperature and precipitation is likely to increase in all populations in the Mad River. Ocean acidification (Feely et al. 2008) will also likely negatively affect adult salmonids and eulachon along with changes in ocean conditions and prey availability.

Urban/Residential/Industrial Development
Population growth and development, especially in the Arcata and McKinleyville area, will continue to present a medium threat to salmonids in the Mad River because it results in removal of vegetation, increased sediment delivery, introduction of exotic species, and increased landscape coverage with impervious surfaces that alters water transport on land and subsequently affects instream flows. Most of the growth within Humboldt County is in the Arcata and McKinleyville area (projected at 0.6 percent annually), resulting in more water diverted from the lower Mad River. All of these activities are expected to result in a degradation of habitat for salmonids and eulachon in the action area.

Fishing and Collecting
Based on estimates of the fishing exploitation rate, as well as the status of the population relative to depensation and the status of NMFS approval for any monitoring-related scientific collection, these activities pose a medium threat to adult salmonids which means that the populations will be reduced. A significant recreational fishery occurs in the lower Mad River primarily because the the Mad River Hatchery produces winter steelhead for angler harvest. Additionally, the Mad River is very accessible by bank fishers. Chinook salmon, coho salmon, and winter and summer steelhead are all vulnerable to impacts from recreational fishing during seasons that overlap with adult presence in the Mad River. The actual impacts to these populations is currently not known because no monitoring of harvest currently occurs.

Bycatch in commercial ocean fisheries (shrimp) is considered the second highest threat to eulachon, only behind climate change in its effects to populations. There is no freshwater fishery for eulachon in the Mad River.

Road-Stream Crossing Barriers
Road-stream crossing barriers impede juvenile and adult salmonid migration and are considered a low threat to the population. Many of the road-stream crossing barriers in the lower Mad River

and its tributaries have been addressed through culvert upgrades or other improvements (e.g., Powers Creek and Quarry Creek).

Habitat and Species Trends

The current status of habitat in the action area is improving relative to past conditions that lead to the listing of coho salmon, steelhead, and Chinook salmon in the Mad River. Timber harvest practices and road building have changed to reduce sediment inputs and increase future LWD recruitment to the stream channel. Some road systems on private timber land have been upgraded to reduce sediment. Gravel extraction practices have been changed to better control the volume of gravel extracted based on annual sediment recruitment estimates and protect the natural morphology of the stream. The lower Mad River is still influenced by levees and some sections of the river are restricted from occupying floodplains. However, localized restoration efforts including culvert replacement and other barrier removal activities, LWD enhancement, and creation of off-channel habitats will further improve conditions for listed salmon and steelhead in the Mad River.

Population monitoring of salmon and steelhead in the Mad River has been limited until recently. However, this limited monitoring suggests Chinook salmon and steelhead populations are likely increasing over previous estimates with the Chinook salmon being at or above the recovery goal of 3,000 adults and the natural steelhead population near the 9,300 escapement goal. The steelhead population has measurably improved since 2001. The abundance of the coho salmon population is still relatively unknown, but considered at high risk of extinction. However, the single population estimate in 2017 was 1,575 adult coho salmon which is significantly higher than previous estimates (Sparkman and Holt 2020).

2.4.4 Salmonid use of the Action Area

Coho salmon, Chinook salmon, and steelhead have different life history requirements and use the downstream action area in temporally and physiologically variable ways. For example, Chinook salmon may use the downstream action area for spawning, but steelhead and coho salmon do not, primarily because they have access to tributaries during upstream migration and they prefer the smaller substrates and lower gradients found in tributary streams. Chinook salmon fry are particularly dependent on the action area because they hatch there and finding suitable slow velocity edgewater habitat immediately upon emergence (within minutes to hours) is especially critical to their survival. Therefore, Chinook salmon fry are more dependent on the action area for rearing, but NC steelhead and coho salmon fry may also use these areas shortly (within days) after hatching and migrating out of tributaries for density dependent or other reasons. Most Chinook salmon juveniles outmigrate by June 30th. Water temperatures are typically too warm in the summer to support juvenile coho salmon rearing in the downstream action area, but they are found in areas where seeps or other cold water refugia provide suitable temperatures and rearing habitat. Steelhead juveniles may rear in the downstream action area year around. This variability in different species and life history use of the downstream action area is important to understand the potential effects of the action and is summarized in Table 2, below.

Table 2. Life history periodicity table for Chinook salmon, steelhead, and coho salmon in the downstream action area.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chinook Fry/Juv		X	X	X	X	X						
Chinook Adult	X								X	X	X	X
Chinook Spawning	X									X	X	X
Steelhead Fry/Juv	X	X	X	X	X	X	X	X	X	X	X	X
Steelhead Adult	X	X	X	X	X	X				X	X	X
Steelhead Spawning	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Coho Fry/Juv	X	X	X	X							X	X
Coho Adult	X	X								X	X	X
Coho Spawning	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

The upstream action area immediately below Matthews Dam is likely not used by juvenile or adult coho salmon, steelhead or Chinook salmon because of a series of high gradient river reaches and large boulder fields that form a natural barrier to migration. In the event that river conditions provide passage above for steelhead, the upstream action area would not provide suitable spawning habitat because of the lack of gravel below the dam and the armoring of the streambed.

2.4.5 Eulachon use of the action area

Eulachon use the downstream action area for migration, spawning, and incubation. Adult eulachon likely enter the Mad River from the ocean from December through March and the eggs incubate from 3 to 8 weeks before hatching when the larvae are swept downstream into the estuary for short-term rearing and then enter the ocean.

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 (see 50 CFR 402.02). 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 the factors set forth in 50 CFR 402.17(a) and (b).

We expect both interior and coastal populations of steelhead exposed to the proposed action to occur in the action area and, therefore, will be similarly exposed to the proposed action.

2.5.1 Effects to Water Quality

Turbidity and Sedimentation

Research has shown that length of exposure to total suspended solids (TSS) plays a more dominant role than TSS concentration (Anderson et al. 1996). Long term exposure to elevated TSS conditions may cause an endocrine stress response (elevated plasma cortisol, glucose, and hematocrits), suggesting an increased physiological burden that could influence growth, fecundity, and longevity (Redding et al. 1987). Therefore, when considering the effects of TSS on listed fish, it is important to consider the frequency and the duration of the exposure, not just the TSS concentration (Newcombe and Jensen 1996).

Elevated sediment entrainment and deposition reduces benthic macro-invertebrate (food) by reducing primary productivity, thereby hindering feeding opportunity for exposed juvenile coho salmon, Chinook salmon, steelhead, and eulachon. In addition, suspended material will result in increased turbidity, potentially making salmonid and eulachon prey and predator detection more difficult.

Short periods of turbidity are expected during in-water construction activities including berm installation, river equipment crossings, revetment maintenance and repair, Ranney collector access activities when conducted in the wetted channel, dredging of the forebay, Station 6 trench construction and Matthews Dam spillway sediment and debris removal. Additionally, ground disturbed by the project will be stabilized to the extent practicable, but some discharge of sediment is possible during the first rains of each subsequent winter season. Measures intended to minimize discharges of sediment are summarized in sections 1.3.2 and 1.3.3 above and are described in HBMWD's biological assessment (BA) (Stillwater Sciences 2022). We do not expect that the amount of sediment released would result in either pool filling or significant filling of the interstitial spaces between gravel and cobble-sized rock such that it would result in armoring of the river bottom.

NMFS estimates that turbidity pulses during the summer construction seasons would persist for up to a day and would vary in intensity during those periods. The largest turbidity pulse in both level and duration is expected from the instream berm construction and could last up to a day, including during the time the instream work is occurring. The second highest turbidity and pulse levels would be from the Ranney collector maintenance and the trench excavation activities and those are expected to last up to 2 hours post-instream work based on monitoring conducted (Halligan 2020). The next highest turbidity increases would be from the dredging that we expect to last no longer than 2 hours and these increases would likely occur when background turbidities are highs. Finally, the turbidity from revetment maintenance and equipment crossings are expected to only last a short time, no longer than 1 to 2 hours. None of the turbidity increases are expected to rise to a level that fish are injured or killed, but there might be short-term changes in behavior to avoid the turbidity plumes and feeding could be reduced during a portion of the time that fish are exposed.

The turbidity pulse from the berm construction is likely to occupy the whole channel and extend up to about 1500 ft distance downstream. The smaller pulses from trench construction, forebay dredging, collector maintenance, and revetment work are unlikely to occupy the full channel width at high concentration and are expected to only reach 300 feet downstream (Halligan 2020). The turbidity pulses associated with the activities in the upstream action area, which include revetment maintenance and spillway dredging, are not expected to create turbidity that would reach rearing juvenile salmon and steelhead or adult summer steelhead because of the significant distance Matthews Dam is above the barriers to adult migration and juvenile rearing.

Reduced Feeding and Growth

Elevated sediment entrainment and deposition can reduce benthic macro-invertebrates (food) by reducing primary productivity, thereby hindering feeding opportunity for juvenile coho salmon, steelhead, and Chinook salmon. Eulachon are not expected to experience reduced feeding opportunities because they are expected to spend little time within the downstream action area as larvae and they won't be exposed in the summer. Any work done in the summer in the downstream action area is expected to reduce macroinvertebrate production and reduce feeding for juvenile salmonids. However, most Chinook juveniles (over 90% of the population) are expected to have left the Mad River by the time instream work would begin (June 30) and only a very limited portion of the population (less than 1% based on the small action area relative to the available habitat area in the Mad River watershed and the expectation that the few Chinook salmon juveniles that may still be in the Mad River watershed after June 29 are not all congregated in the small action area) would be exposed in the action area for only a few days, at the most. Therefore, NMFS does not expect that juvenile Chinook salmon would experience reduced growth as a result of the exposure.

Similarly, few coho salmon are expected to be exposed in the downstream action area because juvenile coho salmon habitat occupancy in the action area during the summer after June 29 would be extremely limited because of high temperatures and limited suitable habitat (pools with overhead and instream cover and cold water thermal refugia) in the action area. Therefore, NMFS does not expect that juvenile coho salmon would experience reduced growth as a result of the exposure.

Juvenile 0+, 1+, and possibly 2+ year classes of steelhead are expected to be in the action area during the instream construction period. The number of steelhead of different year classes residing in the downstream action area is unknown, but we expect it to comprise less than 1% of the total juvenile steelhead population in the Mad River. Additionally, because of the long freshwater residency of steelhead, we do not expect that reduced feeding because of reduced benthic macroinvertebrate production in the downstream action area would reduce growth to the extent that predation risk or reduced size at ocean entry would result in reduced survival of exposed juvenile steelhead.

The proposed work in the upstream action area may also generate turbidity and sediment, although the concentration and duration is expected to be limited. Additionally, the upstream action area is a relatively high energy environment so we do not expect deposition of sediment in the upstream action area will decrease macroinvertebrate production. Therefore, we do not expect the proposed implementation in the upstream action area would create enough turbidity and sediment to reduce growth of individuals many miles downstream of the activities near Matthews Dam.

NMFS believes that any discharges that may result in exposure of adult and juvenile salmonids appear to be little impacted by the high concentrations of suspended sediments that occur during winter storm runoff episodes (Bjornn and Reiser 1991). Therefore, any behavioral or physiological impacts due to exposure to elevated turbidity will be miniscule.

Pollutants Associated with Instream Heavy Equipment Use

HBMWD will manage potential discharge of harmful levels of contaminants from heavy equipment in accordance with the proposed minimization measures. HBMWD measures are consistent with standards for instream construction and have proven effective, so NMFS believes that harmful discharges are improbable.

2.5.2 Noise, Disturbance, and Fish Relocation

The proposed instream construction will result in behavioral impacts to juvenile and adult steelhead, juvenile and adult Chinook salmon, juvenile coho salmon, and, potentially, eulachon. Additionally, there will be impacts from physical relocation of fish from specific activities as well as potential effects from contact with construction equipment. These impacts are discussed below under each action.

Dredging of the Forebay

Dredging of the forebay will primarily occur in the winter months when juvenile and adult steelhead, juvenile and adult Chinook salmon, juvenile coho salmon, and adult and larval eulachon may be present in the forebay. The forebay includes an instream concrete structure and a deeper area than the adjacent Mad River, which results in adult and juvenile use of the area for rearing and holding. After hatching, newly emergent Chinook salmon, coho salmon, steelhead fry and eulachon larvae (if they spawn at or above the forebay location) are likely to be found in the forebay because an eddy occurs as a result of the abrupt turn and increased depth in the forebay and the poor swimming ability of the salmonids and eulachon. Adult coho salmon are expected to migrate through the downstream action area and not hold in the forebay. Adult eulachon may also use the forebay and the river just outside of the forebay for spawning.

The HBMWD proposes to create a behavioral response to frighten fish out of the way of heavy equipment during the dredging. This would likely be effective for temporarily moving adult steelhead and Chinook salmon away from equipment, but this technique is likely to be ineffective for moving all juvenile salmonids out of the way of equipment. We do not expect that adult steelhead, coho salmon or Chinook will be injured or killed by this temporary behavioral shift in their location as a result of the dredging as there is adequate habitat for holding nearby.

Adult eulachon, and potentially, eulachon eggs, may be injured or killed by the forebay dredging if they are present. Since the sediment that accumulates in the forebay may include substrate used by eulachon for spawning (sand and gravel), eulachon eggs could be removed and killed as a result of the dredging. We cannot accurately estimate the number of eggs, larvae, or adult eulachon will be injured or killed during the dredging because there are no estimates of the number of eulachon that migrate into the Mad River each year to spawn. It is likely that no eulachon spawn in the Mad River during some years. The dredging location is relatively small compared to the amount of available spawning habitat within the critical habitat designation in the Mad River, so there might be no spatial overlap between spawning and the forebay dredging location.

Similarly, newly emergent Chinook, coho salmon and steelhead fry may be unable to effectively avoid the equipment and would be injured or killed by contact or removal during dredging. Estimating the number of Chinook, coho salmon and steelhead fry that would be injured or killed by dredging is not possible because of the variable timing of when the dredging would occur, the variability in river conditions during dredging, the number of dredging actions each season, and the suitability of the area for fry rearing at the time of dredging. Additionally, the high variability in fry numbers because of the annual variability in population size makes it even more challenging to estimate. Some fry are also expected to avoid equipment when dredging occurs. However, salmonid fry are not strong swimmers so they are expected to be found in the forebay in low numbers after being swept into the forebay eddy during higher flows (which is also why sediment deposits there).

While NMFS cannot estimate the number of coho salmon, Chinook salmon, steelhead and eulachon that may be injured or killed during the winter dredging, the amount of habitat that the 10,000 square foot dredge area represents is comparably minute compared to all of the potential habitat in the Mad River. Additionally, the downstream action area where the dredging occurs is below most of the spawning habitat for Chinook salmon and all of the spawning habitat for coho salmon and steelhead, which mostly spawn in tributaries to the Mad River. Therefore, we believe that the portion of the Chinook and coho salmon, and steelhead fry that may be killed or injured during the dredging represents a small portion of their populations in the Mad River.

Berm Construction

Berm construction is expected to temporarily and permanently displace juvenile steelhead, coho salmon and Chinook because of changes in the stream morphology and filling of habitat with berm material. Additionally, 0+ juvenile steelhead would be isolated or stranded in areas expected to dry out as a result of changes in morphology and elimination of stream flow. Few coho and Chinook salmon are expected to be in the vicinity of the berm construction because of the timing (after June 30^{th}) and the habitat is marginal with limited overhead cover. A fish biologist is expected to be onsite during berm construction to minimize the number of steelhead juveniles injured or killed by netting and relocating fish, as well as directing equipment operators during instream work, but we do not expect all fish to avoid injury or death.

Additionally, the behavioral displacement of steelhead, coho salmon, and Chinook salmon juveniles is likely to result in behavioral impacts to juvenile steelhead, coho and Chinook salmon occupying areas where displaced fish will attempt to reside. However, these behavioral impacts are not expected to injure or kill juvenile steelhead, coho salmon or Chinook through temporary changes in feeding rates or behavioral impacts between fish. The extended freshwater rearing period for juvenile steelhead before smolting (2+ years) will allow exposed 0+ and 1+ age fish to overcome this temporary reduction in feeding and effectively grow to a smolt size that will result in unaffected survival to ocean entry. Additionally, the small numbers of coho salmon, which typically occupy different habitat areas from both steelhead and Chinook salmon juveniles, are expected to be able to find suitable habitat without affecting other coho salmon juveniles. Finally, Chinook salmon juveniles are undergoing smoltification during the time when the berm is constructed so they are not expected to reside in the action area for a substantial amount of time before moving downstream to the estuary and the Pacific Ocean, which will minimize any overlap between relocated Chinook salmon and their unaffected cohorts.

While fish relocation substantially avoids impacts from construction, fish relocation activities can injure or even kill fish. The amount of unintentional injury or mortality attributable to fish removal varies widely depending on the method used, ambient conditions, and the expertise and experience of the field crew. Fish collecting gear, whether passive or active poses some risk to individuals, including stress, disease transmission, injury, or death (Hayes et al. 1996). In addition, relocated fish may have to compete with other fish for available resources such as food and habitat, may be preyed upon at the release time, and the growth rate of fish can be slowed when population density is high (Ward et al. 2007).

Based on analyses of fish relocation data collected across the north coast, and proposed fish biologist guidance, NMFS expects any injury or death of listed species due to fish collection and handling will be minimal. A CDFW analysis of data from two years of fish relocation activities in Humboldt County showed that mortality rates associated with individual fish relocation sites were less than 3% and the mean mortality rates for all sites was less than 1% (Collins 2004). Further, a NMFS (2012) review of all Fisheries Restoration Grant Program (FRGP) annual monitoring reports of dewatering and relocation activities for 99 projects across 8 years showed less than 1% of relocated steelhead perished. However, fish relocation occasionally resulted in injury or mortality above the average 1%. Therefore, NMFS estimates that approximately up to 3% of relocated salmonids die due to impacts of relocation.

The last time the berm was constructed was on June 28, 2006, which is close to the time when the proposed action would be implemented (July 1 or later) (Halligan 2006). The trench was also constructed at this time. A pre-project dive survey, which included areas outside of the immediate area where the berm was constructed, observed a large number (not enumerated) 0+ steelhead, 9 age 1+ steelhead, 9 2+ steelhead, 69 juvenile Chinook salmon, and 2 0+ coho salmon (Halligan 2006). The coho salmon were observed in the pool below where the berm was constructed. No fish were observed in the area where the trench was constructed (Halligan 2006).

During berm construction, 116 0+ steelhead, 23 age 1+ steelhead, and 5 0+ juvenile Chinook salmon were collected and immediately relocated below the construction area. Five 0+ steelhead were found dead during the fish relocation of which 3 had jumped out of buckets the fish were collected in (Halligan 2006).

We cannot estimate the number of fish that might be residing in the area where the berm construction occurs because of annual changes to habitat features in the action area. However, we believe the results of the berm construction in 2006 provide insight into how many fish of each species might be collected in the berm construction location. We doubled the number of fish that might be collected during the 2006 berm construction to account for differences in population and habitat that may occur at the berm location during any given year. Therefore, we estimate that up to 232 0+ steelhead, 46 1+ steelhead, and 10 0+ Chinook salmon might be captured and relocated during berm construction. If we assume up to 3% of these fish collected may be injured or killed as a result of collection efforts, we estimate that 6 0+ steelhead, 2 1+ steelhead, and 1 0+ Chinook salmon will be injured or killed as a result of the berm construction activities. No coho salmon juveniles are expected to be injured or killed as a result of the berm construction activities because the berm is not constructed in habitat that coho salmon prefer (i.e., pools with overhanging vegetation).

Construction Access to Ranney Collectors

HBMWD proposes to construct roads and work pads to conduct maintenance on their Ranney collectors, which may require the filling of scour holes in the channel. These scour holes may hold 0+ steelhead juveniles at the time of this construction work, which will be moved by a fishery biologist.

HBMWD last conducted Ranney collector #4 maintenance in 2019. During that work, 7 0+ steelhead were relocated to conduct the maintenance (Halligan 2020). NMFS assumes that this is representative of how many steelhead might be relocated at each collector to perform maintenance. We also assume that up to twice as many steelhead juveniles might be found at each collector to account for annual differences in fish production as well as differences in habitat. Therefore, we expect that maintenance at collectors 1, 2, 4 and 5 might result in the relocation of up to 14 juveniles per collector (56 juvenile steelhead) per year. We do not expect that coho salmon or Chinook salmon will be found in the vicinity of the collectors and require relocation because the collector maintenance is typically done during the lowest river flows in the late summer and coho salmon and Chinook salmon will have left these areas for more suitable habitats or the ocean prior to the work commencing. We assume that up to 3% of the juvenile steelhead will be injured or killed during the relocation, which results in up to 2 0+ steelhead being injured or killed during collector maintenance.

Trench Construction

In addition to the turbidity and suspended sediment effects discussed earlier, NMFS does not expect that the instream excavation (up to 2,225 cubic yards) associated with the trench construction would injure or kill any juvenile salmonids because of the timing (June 30th to September) and site conditions of the proposed trenching area near Station 6 (shallow water and no instream or overhead cover). Halligan (2006) did not observe salmonids in the area where the trench is constructed prior to trench construction in 2006.

Rock Revetment Repair and Maintenance

The HBMWD proposes to maintain and repair existing rock revetments and weirs as part of the proposed action. Where the repair of these rock structures would require more extensive work other than simply adding additional rock and might require isolation from the wetted channel, fish relocation might be required in areas that need to be isolated from the flowing channel as fish may become trapped behind containment and isolation structures. Because the revetment repair activities would occur near the collectors, the instream activities are similar to the collector maintenance in terms of instream construction work, and assuming juvenile steelhead abundance and densities are similar between the rock revetment area and the collectors, NMFS anticipates up to 56 0+ steelhead may be relocated as part of these activities with an anticipated mortality rate of 3% or 2 0+ steelhead. Again, no Chinook or coho salmon are expected to be exposed to the construction activity because of the timing of the in-water work and the timing and life history of coho and Chinook salmon and their use of the action area. Because the channel located within the action area for rock revetment maintenance is not an area where significant meandering and channel change is expected, these revetments will have only a negligible effect on stream morphology. We expect minor impacts to riparian vegetation where revetments occur and maintenance is conducted, but these riparian effects are not expected to result in a detectable effect to feeding or cover in the action area.

2.5.3 Effects to Critical Habitat

2.5.3.1 Effect to Salmon and Steelhead Critical Habitat

As previously described in detail in this *Effects of the Action* section, the majority of effects from the proposed action will be in the form of effects to PBFs, such that the effects to critical habitat will occur from: (1) increases in turbidity and sediment deposition affecting water quality, food sources, feeding, and sheltering and (2) localized decreases in feeding and sheltering from changes to the channel morphology from the berm construction and inhibition of riparian vegetation establishment and growth where revetments are maintained.

We do not expect a reduction in the amount of critical habitat from revetment maintenance because the stream channel in the action area is in a confined valley and meandering potential is limited. A minor decrease in the quality of cover and food from riparian sources is expected because of the small reduction in riparian and food from the ongoing existence and maintenance of the revetments. We expect these effects to be limited to the downstream action area and the upstream action area's critical habitat effects will be discountable because it is also in a confined valley and habitat for rearing and spawning is limited or nonexistent and the proposed action will not measurably decrease what limited functioning habitat does exist. We expect the impacts to water quality, feeding, and sheltering to be limited to within 1500 feet of Station 6 and the berm construction, trench construction and other instream activities that generate sediment as described above. We do not expect this to occur every year of the ten year permit period because the activities are not expected to occur each year. We also do not expect these effects to persist beyond the year when these activities occur, except the minor effects from revetment maintenance and existence. We expect that there will be PBFs, such as water quantity, water temperature, safe passage conditions and salinity, within the action area that will not experience decreases in conservation value.

2.5.3.2 Effects to Eulachon Critical Habitat

Specific PBFs that are essential for the conservation of eulachon were identified as: freshwater spawning sites and freshwater migration corridors; estuarine areas; and nearshore marine areas. Within these PBFs, the essential elements for eulachon conservation include: (1) Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation; (2) Freshwater and estuarine migration corridors free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted; (3) Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival (76 FR 65323). The only activity expected to affect eulachon critical habitat is the forebay dredging, which occurs in the winter when adult eulachon might be present. Therefore, we expect up to 10,000 square feet of spawning and incubation habitat will be degraded in quantity and quality as a result of the proposed action.

2.6. Cumulative Effects

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

We anticipate that ongoing activities related to urbanization, agriculture, forestry, and recreation (e.g., fishing) will continue to affect habitat and listed Chinook salmon, coho salmon, and steelhead survival, as described in the environmental baseline.

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 earlier in the discussion of environmental baseline (Section 2.4).

2.7. Integration and Synthesis

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

2.7.1 Effects on SONCC Coho Salmon

2.7.1.1 Population Size

Tributaries outside of the action area are used for coho salmon spawning, but the action area provides rearing and migratory habitat for both fry and juvenile coho salmon, primarily in the winter and spring when temperatures in the action area are suitable for coho salmon. Our analysis of the effects indicates that the proposed action will result in an unquantifiable, but small proportion of Mad River coho salmon fry during forebay dredging operations each winter. Although these fry lost each year could translate into a small decrease in the number of smolts that enter the ocean, given the overall size of the smolt population entering the ocean and the mortality during freshwater and ocean rearing (over 90%), we do not expect this to affect the overall return of adult coho salmon to the Mad River. We do not expect the coho salmon population size will be affected by the temporary impacts to critical habitat from the proposed action. The effects of climate change, including increases in temperature, changes in precipitation patterns and amounts, and ocean conditions that result in poor survival are not expected to be affected or enhanced by the proposed action. Therefore, although we expect a slight reduction in the number of fry, we do not expect an appreciable reduction in the number of returning adults in the SONCC coho salmon population. The effects of climate change, including increases in temperature, changes in precipitation patterns and amounts, and ocean conditions that result in poor survival are not expected to be affected or enhanced by the proposed action.

2.7.1.2 Population Productivity

As discussed above, the proposed action is expected to primarily result in a small decrease in the number of coho salmon fry in the Mad River. However, the reduction in the number of smolts that survive and enter the ocean is expected to be even smaller because coho salmon reside in freshwater up to 1.5 to 2 years so this loss of fry is expected to be within the natural range of freshwater mortality in the Mad River, and will not appreciably reduce the number of returning adults. Climate change and ocean productivity declines will continue to affect the productivity of coho salmon in the Mad River and the ESU regardless of implementation of the proposed action. Therefore, we do not expect the slight reduction in productivity from the proposed action will measurably affect the productivity of the Mad River coho salmon population.

2.7.1.3 Spatial Structure

The proposed action will not impede the ability of coho salmon to access habitat within or outside of, the action area. Therefore, the spatial structure of the Mad River coho salmon population is not expected to be reduced.

2.7.1.4 Diversity

The diversity of coho salmon within the Mad River is not expected to be reduced by the loss of a small number of coho salmon fry. Therefore, since phenotypic or genotypic changes are not expected, we do not expect a reduction in the diversity of the Mad River coho salmon population.

2.7.1.5 Summary

The Mad River coho salmon population is an independent population in the SONCC coho salmon ESU, and was at moderate risk of extinction (NMFS 2014). Recent surveys indicate that the Mad River coho salmon population may have improved since 2014. However, overall, the status of the SONCC coho salmon ESU continues to be threatened since a majority of the independent populations in the SONCC ESU have depressed population size and are at high risk of extinction. Although we expect a small, annual reduction in the number of fry and juveniles, we do not expect that these reductions will result in an appreciable reduction to the likelihood of survival and recovery of the Mad River SONCC salmon population. Under a similar proposed action over the previous ten years, adult coho salmon numbers have increased in some years. We believe this shows that coho salmon productivity is not affected by the proposed action such that the Mad River population and ESU cannot survive and recover if the baseline continues to improve as a result of regulation of other activities and restoration activities. Climate change and ocean productivity declines will continue to affect the productivity of coho salmon in the Mad River and the ESU in some years regardless of the proposed action. Therefore, the viability of the Mad River population of SONCC salmon will not be affected to the extent that the ESU's ability to survive and recover will be appreciably reduced.

2.7.2 Effects on CC Chinook Salmon

2.7.2.1 Population Size

Our analysis of the effects indicates that the proposed action will result in the loss of an unknown, but small number of Chinook salmon fry during forebay dredging and berm construction each year. Although these fry lost each year could translate into a small decrease in the number of smolts that enter the ocean, we do not expect this to affect the overall return of adult Chinook salmon to the Mad River because many of these smolts die during ocean rearing (over 90%). We do not expect the Chinook salmon population size will be affected by the temporary impacts to critical habitat from the proposed action that would occur outside the Chinook juvenile rearing period. The effects of climate change, including increases in temperature, changes in precipitation patterns and amounts, and ocean conditions that result in poor survival are not expected to be affected or enhanced by the proposed action. Therefore, although we expect a slight reduction in the number of fry, we do not expect an appreciable reduction in the number of returning adults in the CC Chinook salmon population.

2.7.2.2 Population Productivity

As discussed above, the proposed action is expected to primarily result in a small number of Chinook salmon fry (10 per year) collected during berm construction with up to 1 being injured or killed. Additionally, an unknown, but relatively small number of Chinook salmon fry are expected to be killed or injured during the forebay dredging. However, the reduction in the number of smolts that survive and enter the ocean is expected to be small and not appreciably reduce the number of returning adults. Climate change and ocean productivity declines will continue to affect the productivity of Chinook salmon in the Mad River and the ESU regardless of implementation of the proposed action. Therefore, we do not expect the slight reduction in productivity from the proposed action will measurably affect the productivity of the Mad River Chinook salmon population.

2.7.2.3 Spatial Structure

The proposed action will not reduce access of the Mad River Chinook salmon population to areas currently available. Therefore, there will be no impact to spatial structure from the proposed action.

2.7.2.4 Diversity

The diversity of Chinook salmon within the Mad River is not expected to be reduced by the loss of a small number of Chinook salmon fry. Therefore, since phenotypic or genotypic changes are not expected, we do not expect a reduction in the diversity of the Mad River Chinook salmon population.

2.7.2.5 Summary

The Mad River CC Chinook salmon population is an independent population in the CC Chinook salmon ESU with a low extinction risk and an estimated population which is significantly higher than the recovery threshold. The ESU is not at immediate risk of extinction. Although we expect a small, annual reduction in the number of fry, we do not expect that these reductions will result in an appreciable reduction to the likelihood of survival and recovery of the Mad River CC Chinook salmon population as the population is already above recovery targets and is not expected to be decreased. Under a similar proposed action over the previous ten years, adult Chinook salmon numbers have increased in some years such that recovery targets have been exceeded. We believe this shows that Chinook salmon productivity is not affected by the proposed action such that the Mad River population and ESU cannot survive and recover if the baseline continues to improve as a result of regulation of other activities. Climate change and ocean productivity declines will continue to affect the productivity of Chinook salmon in the Mad River and the ESU in some years regardless of the proposed action. Therefore, the viability of the Mad River population of CC Chinook salmon will not be affected to the extent that the ESU's ability to survive and recover will be appreciably reduced.

2.7.3 Effects on NC Steelhead

The Mad River includes four populations of NC steelhead that will be affected by the proposed action; summer-run and winter-run steelhead for the inland and coastal populations. However, NMFS assumes that individuals from each population will have the same response to the proposed action. Therefore, the assessment below is for all populations because the Mad River population of juveniles are expected to be intermingle.

2.7.3.1 Population Size

The proposed action will primarily affect age 0+ steelhead by injuring or killing them during heavy equipment operations and fish relocations away from construction sites. We expect up to 10 0+ steelhead fry (i.e., 6 from berm construction + 2 from access to collectors + 2 from revetment activities) and 2 1+ juveniles will be injured or killed each year as a result of implementation of the berm, collector and revetment repairs. Additionally, we expect an unknown, but small number of fry will be injured or killed during forebay dredging. Although the BA (Stillwater Sciences 2022) suggested that it is likely that some of the activities would not occur each year (i.e., berm construction, trench construction, and maintenance of rock revetments), we are assuming these activities would occur each year for the purposes of assessing the maximum potential adverse effects on the populations because we do not know how often these activities will occur. This small loss of age 0+ steelhead and 1+ juvenile steelhead translates into a negligible decrease in the number of smolts that enter the ocean, and no reduction in returning spawning adults. Natural-origin smolts are typically 2+ years old, so a loss of a few 0+ and 1+ steelhead is unlikely to translate into a reduction in the number of returning adult steelhead.

NMFS anticipates that juvenile steelhead would also experience some localized reduced feeding and interactions with other steelhead occupying areas where displaced or relocated steelhead would occur. However, we also assume that these 0+ and 1+ steelhead are also likely to recover from any minor reduction in feeding and growth because steelhead juveniles typically reside in freshwater for 2+ years before smolting and going to the ocean.

Given the availability of adequate rearing habitat in other portions of the Mad River watershed and the juvenile steelhead production that occurs in the watershed, it is unlikely that the small reduction in the numbers of fry and juvenile steelhead as a result of implementing the proposed action would appreciably reduce the size of the Mad River steelhead population. In addition, the size of the adult steelhead population seems to be able to respond to improved ocean and freshwater conditions under a similar proposed action that occurred the last ten years (2012-2021). The effects of climate change, including increases in temperature, changes in precipitation patterns and amounts, and ocean conditions that result in poor survival is not expected to enhance the adverse effects of the proposed action. Therefore, NMFS expects that proposed action will not appreciably reduce the size of the NC steelhead populations in the Mad River, diversity stratum, or DPS.

2.7.3.2 Population Productivity

The productivity of the populations is not expected to be reduced because the number of adult steelhead returning is not expected to be appreciably reduced. The negligible reduction in population productivity is expected to be spread among all of the affected steelhead populations in the Mad River and not translate into discernible reductions in adult numbers. Summer and winter steelhead rely on the action area for the same life history requirements and, therefore, are also affected by the proposed action in similar ways. Under the previous ten-year period and a slightly more impactful proposed action (primarily because of the timing of activities was allowed to occur earlier in the summer (after June 1st instead of after June 29th), the Mad River winter steelhead population was able to respond to improved ocean, river, and tributary habitat conditions such that the population approached recovery targets. This suggests a limited adverse effect from the proposed action on steelhead populations.

2.7.3.3 Spatial Structure

The proposed action will not reduce access to habitats currently available to the Mad River steelhead populations. The proposed construction areas are relatively small and temporarily unavailable to steelhead. In addition, fish passage in the Mad River will not be blocked by the proposed action. Therefore, the spatial structure of the steelhead populations is not expected to be reduced.

2.7.3.4 Diversity

Genetic analysis of summer steelhead suggests that the genes for expression of this phenotype exist in all steelhead, but its expression is dependent on other unknown factors that may have changed such that expression of the winter-run type dominates (Arciniega et al. 2016). We do not think that the effects of the proposed action will affect expression of the summer-run phenotype. Since phenotypic or genotypic changes are not expected, the diversity of affected steelhead populations is not expected to be reduced during the 10-year permit.

2.7.3.5 Summary

The coastal and interior populations of winter steelhead in the Mad River are above the depensation levels and have a low extinction risk. Both coastal and interior populations of summer steelhead in the Mad River are below depensation levels and are considered to be at a high risk of extinction. The DPS is not considered to be at risk of immediate extinction. However, the viability of the winter and summer populations of steelhead that use the action area will not be diminished because we do not expect a decrease in adults as a result of the proposed action's potential annual loss of fry and juvenile steelhead. We also expect any decrease in 0+ fry and 1+ juveniles will be ameliorated by the increased productivity of the winter-run steelhead population because of continual improvements to the baseline from changes in forestry practices, increased regulation of stream diversions and cannabis production, improvements in fish passage, habitat restoration actions, and consistent and higher mainstem flows from operations of Matthews Dam in coordination with the HBMWD, which results in increases in summer flows upstream of the HBMWD diversion point in Arcata, California.

Under a similar proposed action over the previous ten years, adult winter-run steelhead numbers have increased significantly in some years. We believe this shows that steelhead productivity is not affected by the proposed action such that the Mad River population and DPS cannot survive and recover if the baseline continues to improve as a result of regulation of other activities. Climate change and ocean productivity declines will continue to affect the productivity of steelhead, especially summer steelhead, in the Mad River and the ESU. However, climate change and ocean productivity will continue to influence the productivity of Mad River steelhead populations regardless of the implementation of the proposed action. Because of the low number of project-related potential 0+ and 1+ steelhead mortality, the proposed action is not expected to decrease the viability of the NC steelhead DPS. Overall, the numbers of spawners are not expected to be appreciably reduce the likelihood of survival and recovery of the population or DPS.

2.7.4 Effects on the Southern Eulachon DPS

2.7.4.1 Population Size

There is currently no information regarding eulachon population size in most coastal streams from the Mad River to the Columbia River. Based on what limited information we have on eulachon in Northern California streams, eulachon presence in the Mad River likely does not occur each year and, when eulachon are present, they are likely in very limited numbers. It is also unknown how many eulachon occurred historically in the Mad River. However, the Klamath River likely had the largest runs in California. We have made a very conservative assumption that a small number of eulachon occur each year in the Mad River and the forebay is a preferred spawning location for eulachon and we expect the winter forebay dredging will destroy eggs and larvae. We assume that the population size of eulachon is most affected by ocean-related impacts and climate change and that this proposed action is not appreciably reducing the eulachon population and this proposed action is not increasing the adverse effects of climate change. Therefore, since the Mad River population at its current level unlikely contributes significantly to the DPS, the slight potential decrease in the eulachon population from the proposed action is not expected to appreciably reduce the DPS size, but may be relatively significant in the Mad River if it is comprised of only a few individuals, which likely don't occur each year in the Mad River.

2.7.4.2 Population Productivity

Given the low numbers of eulachon expected to occur in the Mad River, we expect that the productivity of the eulachon population could be reduced by the potential annual loss of eggs, larvae and adults. However, given the relatively low contribution of the Mad River eulachon population to the overall productivity of the DPS, we do not expect the proposed action will appreciably reduce the productivity of the DPS.

2.7.4.3 Spatial Structure

The proposed action will not inhibit migration of eulachon in the Mad River, so we do not expect it will reduce the spatial structure of the population or the DPS.

2.7.4.4 Diversity

We do not expect that the loss of eggs, larvae and adults will appreciably decrease the diversity of the population or DPS.

2.7.4.5 Summary

The Mad River eulachon population is expected to be very small and likely does not occur each year. As such, the loss of production could be significant at the Mad River scale. However, we do not think that effects to the Mad River population from the proposed action appreciably reduces the DPS' likelihood for survival and recovery because the Mad River does not contribute much to the DPS' overall abundance or productivity.

2.7.5 Effects on Critical Habitat

NMFS approaches its "destruction and adverse modification determinations" by examining the effects of actions on the *conservation value* of the designated critical habitat; that is, the value of the critical habitat for the conservation of threatened or endangered species. We expect the effects of the action to include: (1) increases in turbidity affecting water quality, feeding and sheltering and (2) short term (summer) changes in the morphology of the Mad River from berm construction.

2.7.5.1 SONCC Coho Salmon Critical Habitat

The action area is critical for the conservation of the Mad River population of SONCC coho salmon because all juveniles must use the downstream action area during a portion of their freshwater life stage.

The localized decreases in conservation value of PBFs within the action area will not limit the ability of the Mad River SONCC coho salmon population to respond to favorable ocean conditions and/or improved PBFs outside of the action area. NMFS believes that the proposed action will not preclude improvement of overall habitat conditions in the action area that will support an increase in the population of SONCC coho salmon because the population has positively responded to improvements in the habitat and other regulatory actions. Specifically, habitat in the action area improved during the previous ten-year permit period for HBMWD's maintenance activities from restoration actions and changes to other activities (e.g., gravel mining) outside the purview of HBMWD. We expect more improvements to occur with implementation of restoration actions and managing other activities that may impact critical habitat (e.g., gravel mining). Therefore, NMFS believes that the proposed action, after factoring in the baseline, status, and cumulative effects, will not appreciably reduce the conservation value of SONCC coho salmon critical habitat in the action area or for the entire designation for the species.

2.7.5.2 CC Chinook Salmon Critical Habitat

The action area is critical for the conservation of the Mad River population of CC Chinook salmon because all juveniles must use the action area during a portion of their freshwater life stage. However, NMFS expects most of the impacts to CC Chinook salmon critical habitat will be ameliorated over the winter high flows and prior to it being used by Chinook salmon juveniles over the short period of time they are in the river prior to smolting and entering the ocean.

The localized decreases in conservation value of PBFs within the action area will not limit the ability of the Mad River CC Chinook salmon population to respond to favorable ocean conditions and/or improved PBFs outside of the action area. NMFS believes that the proposed action will not preclude improvement of overall habitat conditions in the action area that will support an increase in the population of CC Chinook salmon because the population has positively responded to improvements in the habitat baseline and other regulatory actions. Additionally, habitat in the action area improved during implementation the previous proposed action from restoration and better management of other activities (e.g., gravel mining) primarily in the form of increased riparian vegetation, and we expect these improvements in the baseline to continue. Therefore, NMFS believes that the proposed action, after factoring in the baseline, status, and cumulative effects, will not appreciably reduce the conservation value of CC Chinook salmon critical habitat in the action area or for the entire designation for the species.

2.7.5.3 NC Steelhead Critical Habitat

The action area is critical to the conservation of Mad River steelhead populations because many individuals of these populations must pass and spend time feeding and sheltering in the action area prior to ocean entry. The proposed action is expected to decrease the conservation value of some of the PBFs in a limited portion of the action area. However, the decrease in conservation value is expected to be localized to the individual site scale, not expected to propagate to the reach scale, and not expected to occur every year of the 10-year proposed action. We expect that there will be critical habitat within the action area that will not experience any decrease in conservation value.

In addition, the localized decreases in conservation value of PBFs within the action area will not limit the ability of the Mad River NC steelhead populations to respond to favorable ocean conditions and/or improved PBFs outside of the action area. NMFS believes that the proposed action will not decrease overall habitat conditions in the action area that will support an increase in the populations of NC steelhead because populations have positively responded to improvements in the habitat baseline and other regulatory actions. Additionally, habitat in the action area improved under implementation of a similar proposed action from 2012-2021. Therefore, NMFS believes that the proposed action, after factoring in the baseline, status, and cumulative effects, will not appreciably reduce the conservation value of NC steelhead critical habitat in the action area or for the entire designation for the species.

2.7.5.4 Eulachon Critical Habitat

NMFS does not expect a measurable reduction in PBFs for eulachon as a result of the proposed action. Therefore, NMFS believes that the proposed action, after factoring in the baseline, status, and cumulative effects, will not appreciably reduce the conservation value of eulachon critical habitat in the action area or for the entire designated area.

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 ESU, CC Chinook salmon ESU, NC Steelhead DPS, or southern DPS of eulachon and is not likely to destroy or adversely modify their designated critical habitats.

2.9. Incidental Take Statement

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without a special exemption. "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. "Harm" is further defined by regulation to include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering (50 CFR 222.102). "Harass" is further defined by interim guidance as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." "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:

Up to 344 0+ steelhead and 46 1+ steelhead, and 10 0+ Chinook fry may be captured each year prior to the berm construction, trenching, collector and/or revetment maintenance. Of those captured, up to 10 0+ and 2 1+ steelhead, and 1 0+ Chinook salmon may be injured or killed each year as a result of fish relocation associated with berm construction, collector maintenance, and revetment. We cannot estimate the number of steelhead, coho salmon, Chinook salmon and eulachon fry, eggs, and adults may be injured or killed during the forebay dredging operations because of the difficulty of observing, enumerating, and estimating eggs and small fish during these activities turbid river conditions in the winter; predation of injured or dead individuals; and the annual variability in fish production. Therefore, we will use a surrogate for fish take equal to the area dredged (10,000 square feet) during each forebay dredging event.

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

NMFS considers the following reasonable and prudent measures are necessary and appropriate to minimize and monitor the take of NC steelhead, CC Chinook salmon, and Southern DPS Eulachon. The Corps (or applicant) shall:

1. Prepare and submit a post-construction report regarding the effects of instream construction and fish relocation.
2. Develop a plan to reduce the need for berm construction, trench construction, and forebay dredging by the end of 2026 (year 5 of the permit) or implement changes to the action that will reduce the take of coho and Chinook salmon, steelhead, and eulachon.
3. Develop a method for monitoring the take of listed coho and Chinook salmon, steelhead, and eulachon during forebay dredging operations by the end of 2023.

2.9.4 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The Corps 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) The HBMWD shall notify NMFS by email or letter of all instream activities that are expected each year. The timeline for notifications shall be: (1) 30 days before planned berm construction, trench construction, collector maintenance, and revetment repair, and (2) one day before each forebay dredging activity. The HBMWD shall limit the forebay dredging to the 10,000 square feet area immediately in front of the forebay.
   (b) The HBMWD shall contact NMFS within 24 hours of meeting or exceeding take of listed species. Notify Dan Free by phone at 707-825-5164 or via email to Dan.Free@noaa.gov. This contact acts to review the activities resulting in take and to determine if additional protective measures are required.
   (c) The HBMWD shall provide a written report to NMFS by January 15 in each year following construction of the project. The report shall be sent to NMFS via email to Dan.Free@noaa.gov or via mail to Dan Free at 1655 Heindon Road, Arcata, California 95521. The reports shall contain, at a minimum, the following information:

      Construction related activities -- The report will include the dates construction began and was completed; a discussion of any unanticipated effects or unanticipated levels of effects on listed salmonids or eulachon, a description of any and all measures taken to minimize those unanticipated effects, and a statement as to whether or not any unanticipated effects had any effect on those listed fish species; the number of listed salmonids killed or injured during project construction; the date(s) and square footage of each forebay dredging; and photographs taken before, during, and after the activity from photo reference points.

      Fish Relocation – The report will include a description of the location where fish were removed and the release site(s) including photographs; the date and time of the relocation effort; a description of the equipment and methods used to collect, hold, and transport salmonids; the number of fish relocated by species for each relocation effort; the number of fish injured or killed by species for each relocation effort and a brief narrative of the circumstances surrounding salmonid injuries or mortalities; and a description of any problems that may have arisen during the relocation activities and a statement as to whether or not the activities had any unforeseen effects.

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

   - HBMWD shall work with NMFS, CDFW, and any other representatives the HBMWD chooses to develop a plan to reduce the need for instream construction work or reductions in take by January 31, 2026.

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

- HBMWD shall draft a monitoring plan for estimating the number of coho, Chinook, steelhead, and eulachon captured, injured and/or killed for NMFS review by December 31, 2023, and shall implement the monitoring plan following NMFS' input.

2.10 Conservation Recommendations

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, "conservation recommendations" are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02).

1) The Corps should require the HBMWD to develop alternatives to berm construction, trench construction, and forebay dredging that reduce impacts to salmonids, eulachon, and critical habitats.
2) The Corps should require the HBMWD to assess the presence and status of eulachon in the Mad River because that information will be necessary for take assessment and the reinitiation of consultation on the HBMWD's HCP.
3) The Corps should require the HBMWD include bioremediation principals to its revetment repair including planting riparian trees within the rocks and other available spaces where the revetment occurs.

2.11 Reinitiation of Consultation

This concludes formal consultation for the proposed issuance of a section 404 of the Clean Water Act permit for the Humboldt Bay Water District's Operations in the Mad River in Humboldt and Trinity Counties, California.

Under 50 CFR 402.16(a): "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: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If 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 written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

2.12 "Not Likely to Adversely Affect" Determinations

NMFS has determined that the proposed action is not likely to adversely affect the Southern DPS of green sturgeon (*Acipensir medirostris*) because they are typically only found in the estuaries of non-natal rivers as their primary purpose for entering these rivers is for feeding and the action area is in a non-natal river located above the upstream extent of the Mad River estuary. Project-related suspended sediment contributions to the Mad River estuary are not discernable from baseline or are so minor that effects to green sturgeon will be discountable (e.g., green sturgeon are very capable of foraging in turbid waters). The potential loss of very few salmonid juveniles each year are expected to have insignificant effects to green sturgeon because green sturgeon will have many other available prey in the estuary. Critical habitat for the southern DPS of green sturgeon is not designated in the Mad River.

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect EFH. Under the MSA, this consultation is intended to promote the conservation of EFH as necessary to support sustainable fisheries and the managed species' contribution to a healthy ecosystem. For the purposes of the MSA, EFH means "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity", and includes the physical, biological, and chemical properties that are used by fish (50 CFR 600.10). Adverse effect means any impact that reduces quality or quantity of EFH, and may include direct or indirect physical, chemical, or biological alteration of the waters or substrate and loss of (or injury to) benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) of the MSA also requires NMFS to recommend measures that can be taken by the action agency to conserve EFH. Such recommendations may include measures to avoid, minimize, mitigate, or otherwise offset the adverse effects of the action on EFH [CFR 600.905(b)].

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

3.1 Essential Fish Habitat Affected by the Project

HAPCs for salmon affected by the Project is complex channel and floodplain habitat as described in the Pacific salmon FMP.

3.2 Adverse Effects on Essential Fish Habitat

The adverse effects to EFH from the proposed action are included in the effects of the action section of this Opinion. These include changes in the geomorphology of the river from berm construction and localized increases in fine sediment and turbidity.

3.3 Essential Fish Habitat Conservation Recommendations

NMFS determined that the following conservation recommendations are necessary to avoid, minimize, mitigate, or otherwise offset the impact of the proposed action on EFH:

1. Plant areas of their properties that will not interfere with operations, with native conifers, cottonwoods, willows, and alders to create a riparian zone 50 to 100 feet wide from the top of bank. This will help mitigate for the decreased riparian associated with existing rock revetments and help stabilize fine sediment discharge to the Mad River.

2. Explore the use of modern geomorphological restoration techniques to achieve objectives that proposed berm construction, trench construction, and forebay excavation are intended to meet to mitigate or eliminate the effects of these activities on HAPCs. Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, for Pacific Coast salmon.

3.4 Statutory Response Requirement

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

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

3.5 Supplemental Consultation

The Corps must reinitiate EFH consultation with NMFS if the proposed action is substantially revised in a way that may adversely affect EFH, or if new information becomes available that affects the basis for NMFS' EFH Conservation Recommendations [50 CFR 600.920(l)].

4 DATA QUALITY ACT 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 Corps and HBMWD. Other interested users could include citizens of affected areas, others interested in the conservation of the affected ESUs/DPS, and other agencies tasked with permitting the proposed action under their authorities (e.g., California Department of Fish and Wildlife). Individual copies of this opinion were provided to the Corps and HBMWD. The document will be available within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere 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.

4.2 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 part 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, if applicable 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, if applicable, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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