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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802- 4213

MAR 10 2005

MEMORANDUM: File Number 151422SWR1999AR25

FROM:

R. R. McInnis
for Rodney R. McInnis
Regional Administrator

SUBJECT: Biological Opinion on proposed issuance of Incidental Take Permit to Humboldt Bay Municipal Water District

Attached is NOAA's National Marine Fisheries Service's (NMFS) biological opinion (Opinion) for our proposed issuance of an Incidental Take Permit to the Humboldt Bay Municipal Water District. The Opinion addresses the effects of the District's Mad River Operations on Northern California (NC) steelhead (*Oncorhynchus mykiss*), Southern Oregon/Northern California Coast (SONCC) coho (*O. kisutch*) salmon, and California Coastal (CC) Chinook salmon (*O. tshawytscha*) in accordance with section 7(a)(2) of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq.*). The Opinion also evaluates effects of the proposed action on designated critical habitat for SONCC coho salmon, designated on May 5, 1999 (64 FR 24049). In the Opinion, NMFS determined that the proposed action is not likely to jeopardize the continued existence of threatened NC steelhead, SONCC coho salmon, and CC Chinook salmon, and is not likely to destroy or adversely modify designated SONCC coho salmon critical habitat.



BIOLOGICAL OPINION

ACTION AGENCY: National Marine Fisheries Service, Southwest Region, Protected Resources Division

ACTIVITY: Issuance of an Incidental Take Permit to the Humboldt Bay Municipal Water District for covered species under the jurisdiction of the National Marine Fisheries Service

CONSULTATION CONDUCTED BY: National Marine Fisheries Service, Southwest Region

FILE NUMBER: 151422SWR1999AR25

DATE ISSUED: MAR 10 2005

I. INTRODUCTION

Pursuant to section 10 of the Federal Endangered Species Act (ESA), the Humboldt Bay Municipal Water District (District) has requested an Incidental Take Permit (ITP) on their Habitat Conservation Plan for Mad River Operations (HCP). The HCP includes those activities covered under the proposed ITP (Permit No.1488). As required under section 7 of the ESA, an intra-agency consultation shall be completed analyzing the effects of the issuance of NOAA's National Marine Fisheries Service (NMFS) ITP for the District's HCP. The District has requested an ITP for a 50-year period (period).

The District's Mad River Operations provide water on a wholesale basis to municipal, retail and industrial customers in the Humboldt Bay area. The District's wholesale municipal customers include the cities of Arcata, Blue Lake and Eureka; and the Humboldt, McKinleyville, Manila and Fieldbrook community services districts. Via the wholesale relationship, the District serves a population of approximately 80,000 in the greater Humboldt Bay area. The District's industrial customer(s) are located on the Samoa Peninsula. Two delivery systems, one for domestic use and one for industrial use, convey water from the Essex facilities to the District's wholesale customers.

II. BACKGROUND

Communication between the District and NMFS regarding District operations at Mad River began at an HCP scoping meeting on October 30, 1996, resulting in the development of a first draft HCP submitted to NMFS in 1997. On February 8, 2000, NMFS received a January 19, 2000, letter from the U.S. Army Corps of Engineers (USACE), requesting section 7 informal consultation in accordance with section 7 of the ESA of 1973, as amended (16 U.S.C. 1531 *et seq.*) on the District's maintenance activities requiring a Clean Water Act (CWA) section 404

Permit including maintenance activities associated with the District's Mad River Operations. NMFS responded to the January 19, 2000, letter with a February 29, 2000, letter recommending the "Corps issue the District the permit identified for one year and condition it with the requirement that the District minimize the impacts from their operations to listed and proposed salmonid species to the best of their current knowledge and abilities." A CWA section 404 Permit (no. 24824N) was issued by the USACE to the District effective January 1, 2000 through October 15, 2001. On October 9, 2001, the USACE extended the Permit an additional 12 months until October 15, 2002.

Concurrent to CWA section 404 permitted activities, NMFS was providing technical assistance to the District and participating in the development of the draft HCP. A second draft HCP was submitted on July 11, 2002, for NMFS review. NMFS provided comments on the July 11, 2002, draft HCP on July 26, 2002, and further discussions with an emphasis on developing a Station 6 monitoring plan, ensued.

On September 13, 2002, NMFS received a September 10, 2002, letter from USACE, requesting informal consultation on USACE's proposal to grant the District a time extension to conduct maintenance activities at the Station 6 Facility through October 15, 2003. On January 21, 2003, the District formally submitted a draft HCP and Environmental Assessment (EA) to NMFS for review.

On January 23, 2003, NMFS, the USACE, and the District met in Arcata, California to discuss USACE's request for informal consultation. NMFS provided technical assistance to the District, and based on NMFS' comments and a technical monitoring report of June 2002 maintenance activities (Halligan 2002), USACE amended its September 10, 2002, request with a February 13, 2003, letter. In the February 13, 2003, letter, USACE requested formal consultation pursuant to section 7 of the ESA on the District's maintenance activities for Mad River Operations. NMFS completed a biological opinion on June 12, 2003, for maintenance activities through December 31, 2004.

III. CONSULTATION HISTORY

NMFS received a final HCP, dated October, 2003. On November 5, 2003, NMFS initiated formal intra-service consultation regarding the application by the District for an ITP, pursuant to section 10(a)(1)(B) of the ESA, for its activities on the Mad River. The duration of the ITP and HCP is 50 years.

The objective of this Biological Opinion (Opinion) is to determine whether the effects of issuing an ITP to the District for activities covered under the HCP, taken together with cumulative effects and the effects of the environmental baseline, are likely to jeopardize the continued existence of the Northern California (NC) steelhead (*Oncorhynchus mykiss*) Evolutionarily

Significant Unit¹ (ESU), listed as threatened on June 7, 2000 (65 FR 36074); the Southern Oregon/Northern California Coast (SONCC) coho salmon ESU (*O. kisutch*), listed as threatened on May 6, 1997 (62 FR 24588); or the California Coastal (CC) Chinook salmon ESU (*O. tshawytscha*), listed as threatened on September 16, 1999 (64 FR 50394).

This Opinion also evaluates effects of the Proposed Action on designated critical habitat for SONCC coho salmon, designated on May 5, 1999 (64 FR 24049), and includes conclusions regarding destruction or adverse modification of designated critical habitat. This Opinion will provide incidental take coverage for maintenance activities and supersede incidental take coverage currently covered under NMFS' June 12, 2003, biological opinion.

A complete administrative record for this consultation is on file at the NMFS Arcata Area Office.

IV. PROPOSED ACTION

A. Action Area

An action area is defined as: "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 this consultation is within Humboldt County, California, and includes the area of the Mad River that can be affected by the District's Mad River Operations. The District manages the release of water from R.W. Matthews Dam (Matthews Dam) at Ruth Lake [river mile (RM) 85] to meet its downstream diversion and instream flow requirements. Therefore, the action area includes the entire reach of the Mad River downstream of Matthews Dam to the tidal zone where tidal influences ameliorate the effects of the proposed action (RM 4).

B. Description of the Proposed Action

NMFS proposes to issue an ITP to the District for activities described in their HCP. The District describes two categories of actions covered under the HCP: (1) current activities which occur on an ongoing basis, and (2) current activities which occur only as needed.

¹ For purposes of conservation under the Endangered Species Act, an Evolutionarily Significant Unit (ESU) is a distinct population segment that is substantially reproductively isolated from other conspecific population units and represents an important component in the evolutionary legacy of the species (Waples 1991).

1. Current activities which occur on an ongoing basis

a. *Releasing Flow at Matthews Dam.*

The District operates Matthews Dam at RM 85 on the Mad River to impound and release water to satisfy the District's downstream diversion requirements and minimum bypass flow requirements below the diversions, located between RM 9.1 and 10.8. The 172-foot earthen dam impounds runoff from approximately 121 square miles of the Mad River watershed (25% of the basin), forming Ruth Lake. The capacity of Ruth Lake is approximately 48,000 acre-feet.

A portion of the water stored in Ruth lake is released to satisfy both the District's downstream diversion requirements and minimum bypass flow requirements. As described in the District's State of California Water Rights Permits (Permit Nos. 11714, 11715, March 16, 1959), the District is required to maintain the following minimum flows:

- i. A minimum flow release of five cubic feet per second into the natural streambed of Mad River immediately below Matthews Dam.
- ii. A minimum bypass release into the natural streambed of the Mad River immediately below the Essex Station 6 Facility Diversion (RM 9.1) as described below:
 - October 1 through October 15 30 cubic feet per second (cfs)
 - October 16 through October 31 50 cfs
 - November 1 through June 30 75 cfs
 - July 1 through July 31 50 cfs
 - August 1 through August 31 40 cfs
 - September 1 through September 30 30 cfs

The State permits further define the District's water right appropriation. The amount of water appropriated for use shall not exceed 200 cfs through the District's diversions (*i.e.*, Ranney Collectors and Station 6 Facility). The District is currently under contract with the State of California to withdraw up to 84,000 acre-feet annually. While the current withdrawal rate is much lower (28,000 to 34,000 acre-feet per year), this Opinion analyzes the potential effects of maximum withdrawal on listed salmonids.

The District proposes to conduct on-going, continuous monitoring associated with the proposed flow releases and bypass flows. The District calculates natural flow in the Mad River using flow data which are measured and collected at several locations [inflow into Ruth Lake, releases from Matthews Dam into the Mad River below the dam, and flow at the U.S. Geological Survey (USGS) gage station downstream of Essex]. As such, the District is able to accurately establish its required releases to meet both its downstream diversion requirements and the minimum bypass flow requirements below Essex Reach.

In establishing its release requirements, the District uses daily flow data measured at Matthews Dam or obtained from USGS for its gage stations on the Mad River. Preliminary USGS data used by the District on a daily basis for operational planning invariably differs from USGS published flow data. River cross-sections change; therefore, the USGS periodically establishes a “shift” at a particular station to provide a more accurate representation of the flow. A “shift (also known as a correction factor)”, if established, is applied to the staff gage reading, and the adjusted gage height reading is then used to determine the discharge from the USGS rating table. USGS’ policy is to establish a shift if the discharge measurements taken in the field differ from the rating table results by 6% or more.

If the District receives a correction factor from USGS and determines that the bypass flow downstream of Essex no longer meets the minimum requirements, the District will immediately increase its release from Ruth Lake. The transit time of flow released from Matthews Dam is approximately 72 hours for the increased flows to arrive at the Essex Reach and the downstream USGS gage station near the Highway 299 bridge in Arcata. Consequently, the District could be out of compliance with respect to the minimum bypass flows below Essex for a period of up to three days following receipt of a new USGS correction factor.

As part of its monitoring program, the District will submit the following data to NMFS:

- Daily discharge data from Matthews Dam;
- Daily diversions at Essex;
- Daily calculation of natural flow below Essex;
- Daily discharge data from USGS station downstream of Essex;
- A statement as to whether or not the District satisfied its bypass flow requirements; and
- Copies of correction factors received from the USGS, with a statement documenting whether the correction factor affected the District’s ability to meet its minimum bypass requirements, and if so, whether the District increased its releases from Ruth Lake.

b. Diverting water in the Essex Reach of the Mad River

The District is permitted to withdraw up to 75 million gallons per day (MGD) total in the Essex Reach through Ranney collectors and surface diversion. Water is diverted for domestic and industrial use in four Ranney collectors. The Ranney collectors draw water from the aquifer approximately 75 feet below the bed of the river. In addition, the District diverts up to 60 MGD of water for industrial customers at the Station 6 Facility. River flow is diverted into the forebay and pumped into the facility. The District is permitted a withdrawal rate from the Mad River at Station 6 Facility up to 80 cfs, and while the average rate of withdrawal at Station 6 Facility is generally much lower (approximately 17 cfs), this Opinion analyzes the potential effects of maximum withdrawal on listed salmonids.

c. Operating the direct diversion facility, including the fish screens

The District operates a fish screen to allow the District to divert water at the Station 6 Facility at RM 9. Station 6 comprises a forebay, which is directly adjacent to the Mad River and extends transverse to the direction of flow, and a concrete pumping structure. The forebay is trapezoidal in shape and 90 feet wide at the riverbank, tapering to 36 feet wide in front of the trash racks at the back of the forebay. The concrete intake structure is divided into two cells, and each cell has a mechanically operated fish screen located approximately 12 feet in front of the pumps. The fish screens are vertical traveling Rex “four post type” screens. The screen, including the structural framing system, completely fills the opening between the concrete sidewalls and is further guarded along both sides by redwood two-inch by four-inch sealing strips, connected directly to the concrete sidewalls. At the bottom of the screen, a steel boot plate reduces any opening at the screen bottom to less than 3/8 of an inch. The rotation direction of the screen and fish buckets is toward the face of the screen, creating a water movement away from the screen at this point. Each of the two fish screens is 13-feet long and 2-inches wide (frame to frame) and articulated at 2-foot vertical intervals. The screen material is Type 304 stainless steel wire cloth with 3/16-inch square openings.

The frequency of screen runs is determined by the debris present in the water. Normally the screens are set to run for 20 minutes every 96 hours. However, the frequency may increase when the elevation of the Mad River exceeds 23.0 feet at the Station 6 Facility, or the turbidity is over 30 nephelometric turbidity units (NTU). At stage heights greater than 23.0 feet, the District has observed an increase in debris in the forebay. The screens also activate automatically if head loss is too high.

The fish bypass system begins with the fish baskets/troughs attached to the vertical traveling screens. When the screens are in operation, small organic debris or juvenile fish within 4.5 inches of the screen face will be lifted out of the water column, by one of the 58 troughs, which are attached to the screens at two-foot intervals. The troughs are made of carbon steel (12 feet long by two and a half inch deep by four and a half inch wide), and are capable of holding water to support fish. As the troughs pass over the head sprockets, fish slide onto a wire screen where a low-pressure spray directs them to a fiberglass trough. Debris generally remains matted on the basket panels and is removed by a high-pressure spray, which blasts debris into a debris trough located immediately below the fish trough. A low pressure flushing flow runs twenty minutes after the screen has stopped operating, to guide the fish back to the river. The fish bypass system is approximately 390 feet long, and descends approximately 40 feet. Fish are returned to the Mad River below a boulder grade control structure, into a flatwater habitat reach.

Station 6 was designed in accordance with California Department of Fish and Game’s (CDFG) fish screen criteria in 1975. More recently, NMFS (1997a) and CDFG (2000a) have adopted updated fish screen criteria applicable for new facilities. The forebay basin at Station 6 functions like a backwater pool or off-channel slough. Anadromous salmonids of all age classes that enter

the forebay basin are never segregated from their migratory route in the main channel, nor are they prevented from freely swimming out of the facility.

During discussions with NMFS in 2000, the District agreed to comply with NMFS' 3/32-inch screen size opening criterion. The District also agreed to remove the existing buckets on the fish screens and replace them with rakes, thereby eliminating the possibility of lifting fish out of the water.

Monitoring. Through coordination with NMFS, the District developed a three-phase monitoring program for the Station 6 Facility. The HCP describes, in detail, the phases of the monitoring program, and mechanisms to trigger each phase of the monitoring program. The biological goal of the monitoring program is to ensure that the take level (*i.e.*, those fish harmed, harassed, injured or killed) does not exceed 5% of the fish that enter the forebay and become exposed to the fish screens. Each succeeding phase of the monitoring program requires further studies and operational modifications to (1) better estimate the Mad River populations of anadromous salmonids, and (2) further minimize the level of take associated with operating the fish screens. As part of the monitoring program, the District proposes to periodically operate the Station 6 diversion facility at maximum diversion volume, resulting in potentially higher levels of take to juvenile salmonids. These tests will be conducted periodically on an annual basis and will not exceed 30 minutes. Data collected from these studies will help to assess the potential level of take during normal operating conditions.

d. Dredging the Forebay

The District proposes to dredge/excavate each winter to remove accumulated sediment. The Mad River at Essex experiences highly variable water surface elevations; stage height can vary by over 20 feet. The Mad River also experiences high sediment and debris load in the winter. Therefore, a principal design criterion of Station 6 was mechanical removal of accumulated silt and gravel in the forebay to protect the pumps. The District must dredge the forebay after high flow events deposit large amounts of silt and gravel. The frequency of dredging depends on the severity of winter storms but generally varies between 2 and 5 times per month. Either a crane with a clamshell bucket, or an excavator, is used to dredge the forebay to a depth of 10 to 12 feet mean sea level (msl). The crane or excavator is also used, as needed, to clear the channel in front of the forebay, maintaining a continuous water flow in the forebay and the low-flow channel of the river.

e. Maintain adequate water surface elevation at Station 6 Facility

The District requires a sufficient water surface elevation (approximately 21 msl) at Station 6 Facility to maintain adequate flow into the forebay for water diversion purposes. As flows recede and water surface elevation at the Station 6 Facility reaches 21 feet msl, the District proposes to increase the water surface elevation to the Station 6 Facility. The District proposes to construct an earthen berm connecting the rock jetty to the grade control weir downstream to

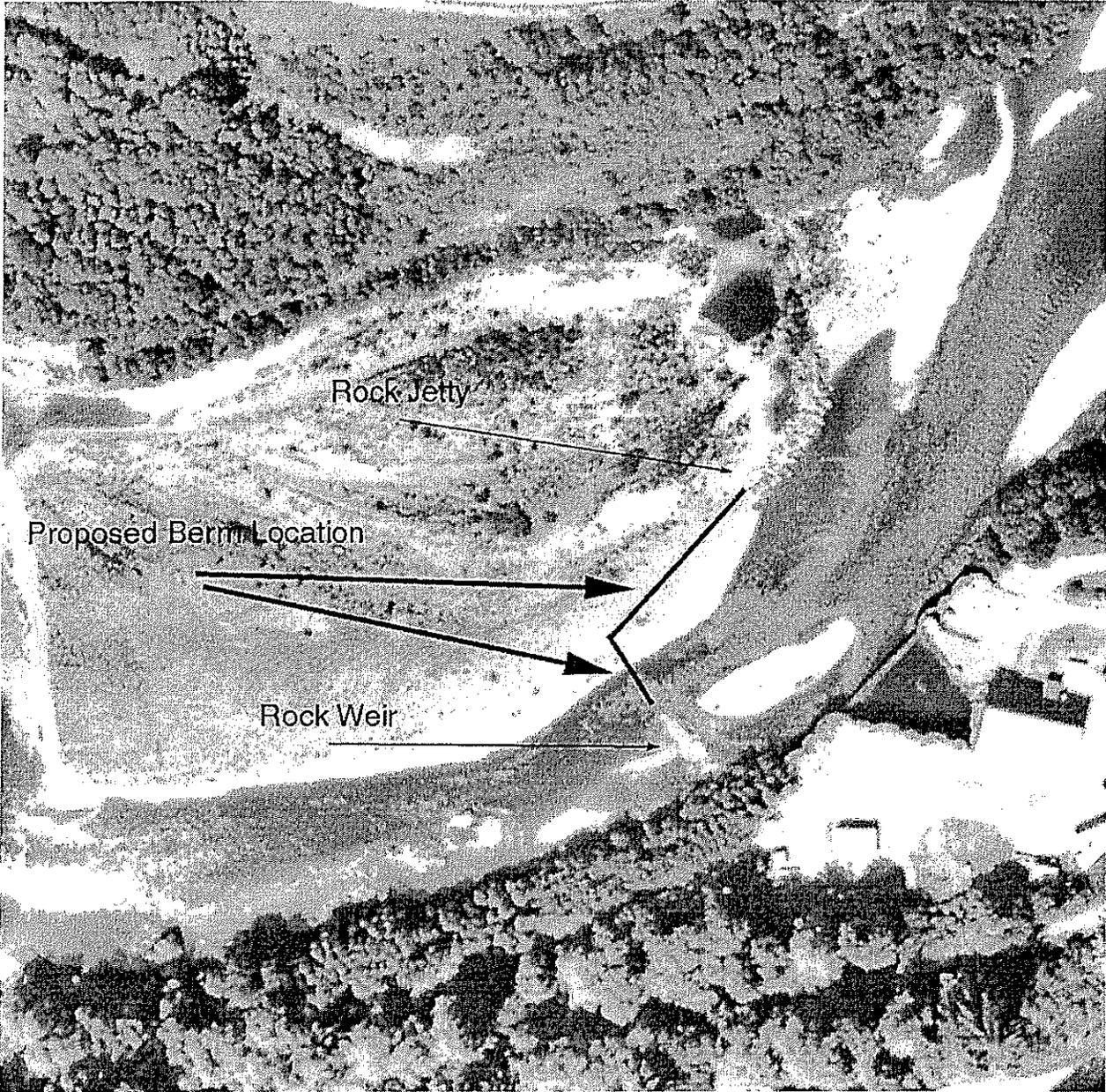
raise the water surface elevation and maintain an adequate flow of water to the Station 6 diversion facility (see Figure 1). The District proposes to construct the earthen berm from river-run gravel derived from the gravel bar directly downstream of the proposed berm site. Heavy equipment (e.g., dozer, excavator, backhoe) will be used to construct the berm. Based on the timing of construction for the previous three years, the District anticipates the berm to be constructed between late May and early June, annually. Historically, the morphology of the Mad River channel varied at the berm site, therefore, the configuration of the berm has varied as well. However, the District anticipates the dimensions of the berm (*i.e.*, footprint) will be approximately 350 feet long, 20 feet wide and 3-4 feet high. The majority of the berm area will cover wetted channel adjacent to the Station 6 facility, covering edgewater and side channel habitat of the Mad River. The berm remains in place until increased flows during storm events erode the gravel. These high flow events occur annually, most likely during annual winter storms.

The District proposes mitigation and monitoring associated with maintaining adequate water surface elevation at the Station 6 Facility. The berm will be constructed such that it occupies the minimum possible area of the low-flow channel. Work will occur in a timely manner to minimize turbidity disturbances (e.g., berm will generally be constructed in less than 6-to-8 hours). During berm construction, the Station 6 pumps will be run to draw as much turbid water into the forebay as possible. Any additional techniques known to the District, and suitable for this work, shall be employed to further minimize turbidity. The District shall exercise every reasonable precaution to protect the stream from fuel or oil spills. Equipment fueling shall not occur within the bankfull channel. All equipment shall be pressure washed and inspected for leaks prior to entering the river bed. Spill containment kits shall be readily available at the work site.

Prior to commencing construction of the berm, a fisheries biologist will inspect the area and determine to what extent juvenile salmonids are present. The biologist, in consultation with the District, will determine if any mitigation measures, over and above the following, are warranted based on the conditions present at the time. During construction, the fisheries biologist shall disperse fish by wading the river ahead of the heavy equipment. Additional personnel shall be available to rescue fish if they become stranded in a pool.

The District shall initiate a study to determine if a more permanent solution is feasible to provide the necessary water-surface elevation during the low-flow months. This study shall include an assessment of the geomorphic conditions at the site; engineering considerations, including navigability; and biological considerations, which shall be determined by the District, NMFS and CDFG. The study shall identify feasible alternatives and shall recommend the preferred alternative. The District shall complete this study within 3 years after obtaining an ITP from NMFS. Any long-term solution that includes channel modifications to the Mad River will require a section 404 permit from USACE, and NMFS will conduct a separate section 7 consultation with USACE to analyze the effects of this future action on listed salmonids.

Figure 1. Aerial Photograph of the Station 6 Facility and Berm Construction site (Cascade Mapping Inc., May, 13, 1994).



f. Maintaining adequate flow to Station 6 Facility

Until a long-term solution to maintain adequate water flow to Station 6 Facility is implemented, the District proposes to dredge a channel in the Mad River directly upstream of the Station 6 forebay. Dredging is likely to occur on an annual basis in conjunction with the construction of the berm, in early June. The configuration and extent of the excavation required will vary depending on: (1) the amount of material which has aggraded in front of Station 6, and (2) the location of the aggraded material in relation to the low-flow channel of the river. In previous years, the area of excavated sediment has been approximately 250 - 500 feet long, 20 feet wide, and up to 4 feet deep. Depending on the configuration of the aggraded channel, the excavation may occur in the active channel or on a dry bar. The District proposes "...the sediment removed during dredging is removed or utilized in the construction of the low flow berm each year to minimize excavation of the adjoining gravel bar" (District 2002). However, in 2002, CDFG required the District to not use the sediment from dredging operations for construction of the earthen berm. Therefore, in 2002, the District stored the excavated material on the dry bar within the floodplain of the Mad River (pers. comm. with B. Van Sickle, Operations Manager, District, April 2003). Until a long-term solution has been implemented, the District proposes to conduct annual pre-construction meetings with NMFS to develop construction plans that minimize impacts to listed salmonids and their habitat.

The District proposes mitigation and monitoring associated with this aspect of the proposed action (District 2002):

The excavation shall be done in such a manner that the excavated area occupies the minimum possible amount of active channel. Work shall occur in a timely manner to minimize turbidity disturbances (*e.g.*, generally less than 4-to-6 hours). The Station 6 pumps will be run to draw as much turbid water into the forebay as possible. Any additional techniques known to the District, and suitable for this work, shall be employed to further minimize turbidity effects. The District shall exercise every reasonable precaution to protect the stream from fuel or oil spills. Equipment fueling shall not occur within the bankfull channel. All equipment shall be pressure washed and inspected for leaks prior to entering the river bed. Spill containment kits shall be readily available at the work site.

During excavation, a fisheries biologist shall disperse fish by wading the river ahead of the heavy equipment. The fisheries biologist shall monitor work and record whether any injury or mortality occurred. The District shall provide pre- and post-construction photographs.

2. Current activities which occur only as-needed

a. Maintaining adequate capacity in tailrace and spillway pools below Matthews Dam

Erosion, resulting from high water events passing over the spillway, periodically results in deposition of material in the plunge pool or tailrace channel outlet (the confluence with the Mad River). In the tailrace channel, aggraded material collects which, in turn, may increase water surface elevation in the tailrace pool. This elevated water surface could result in accelerated bank erosion that threatens the dam face, the hydroelectric facility, or the County road located on the right bank. Aggradation in the past has partially or completely closed off the tailrace channel.

At the spillway plunge pool, rip-rap encased in concrete has been applied on the left bank. This rip-rap should stabilize the bank and minimize erosion. However, erosion during high discharge events may still occur. Additionally, coarse sediment derived from the steep talus slope on the right (east) bank of the spillway may be deposited in the spillway plunge pool.

On an as-needed basis, the District proposes to remove this aggraded material and sediment from the tailrace channel and spillway plunge pool using heavy equipment, such as an excavator. The District anticipates they will need to conduct these maintenance activities on a bi-annual basis, during low flow conditions. The duration of these activities that may affect listed fish is relatively short, less than 20 hours every two years. The tailrace channel, subject to siltation and gravel deposits, covers an area approximately 30 feet by 80 feet (0.05 acres). The spillway plunge pool, subject to siltation and gravel deposits, covers an area approximately 40 feet by 100 feet (0.09 acres). Sediment removed from the forebay is stored on District property at a distance from the Mad River sufficient to ensure no sediment is delivered to the active channel during storm events.

b. Gain access to and maintain Ranney Collectors

The District proposes to maintain collectors, as needed, including repair or installation of new pumps, motors, or other equipment associated with operating the collectors. A crane will be used to conduct these maintenance activities. Temporary roads must be constructed to allow the crane to access equipment on collectors decks. Maintenance requiring the use of a crane and temporary road construction occurs approximately once every five years, during low-flow summer conditions.

If needed, temporary roads to Collectors 1, 2 or 4 will be constructed by pushing native river run materials with a backhoe, front end-loader, or tractor. The roads will be constructed on exposed riverbed outside of the wetted channel, during the dry, low-flow period of summer. General flushing activities may occur as part of this action. The District proposes general flushing activities of its collectors to: (1) remove accumulated sediment, and (2) conduct performance tests. Construction of a temporary berm is necessary to control the run-off generated from these

activities. The berm is constructed by pushing riverbed material approximately three feet high around a portion of the collector. The length and configuration of the berm may vary to ensure no discharge enters the Mad River. The berm will be constructed away from the active channel of the Mad River. Immediately following the completion of these maintenance activities, the District proposes to re-grade all disturbed river bed to the original channel bed topography.

c. Repair Rock Structures and Revetment

The District proposes to maintain rock structures and revetments as needed. Stationary rock structures that are part of the District's facilities include: (1) a grade control weir below Station 6, (2) a rock jetty which projects from the north bank just upstream of Station 6, (3) three wing jetties on the north bank near Station 1, and (4) rock structures protecting the in-river collectors or domestic lines. Rock revetments are located throughout the Essex Reach on banks of the Mad River from Collector 3 to a location just upstream of the Highway 299 bridge. The revetments vary in length from 100 to 800 feet and consist of ¼-ton to 4-ton boulders.

In the event that rock structures or revetments are damaged as a result of high flow events, the District proposes to repair and/or add rock to existing structures. Heavy equipment may be used to move rock. If heavy equipment is required to perform this action, the District proposes to restrict the use of heavy equipment from entering the active channel to the maximum extent practicable. Whenever possible, the District will conduct these maintenance activities during dry low-flow summer months to minimize effects to listed fish and their habitat. The District proposes to use measures to minimize sediment delivery and bank destabilization. The District uses geo-textiles and matting where appropriate to stabilize soils.

V. STATUS OF THE SPECIES AND CRITICAL HABITAT

This Opinion analyzes the effects of the proposed action on three salmonid ESUs listed as threatened under the ESA: SONCC coho salmon, CC Chinook salmon and NC steelhead. In addition, this Opinion analyzes the effects of the proposed action on designated critical habitat for SONCC coho salmon. The critical habitat for SONCC coho salmon includes all accessible waterways, substrate, and adjacent riparian zones, excluding: (1) areas above specific dams identified in the FR notice (*i.e.*, Matthews Dam), (2) areas above longstanding natural impassible barriers (*i.e.*, natural waterfalls), and (3) Federally recognized tribal lands. Federal Register Notice dates and citations, and geographic distributions of these species are summarized below (Table 1).

Table 1. The scientific name, listing status under the Endangered Species Act, Federal Register Notice citation, and geographic distribution of the Evolutionarily Significant Units (ESU) included in this consultation.

	SONCC coho salmon	NC steelhead	CC Chinook Salmon
Scientific Name	<i>Oncorhynchus kisutch</i>	<i>O. mykiss</i>	<i>O. tshawytscha</i>
Listing Status	threatened	threatened	threatened
Updated Status and Proposed Listing	June 14, 2004, 69 FR 33102	June 14, 2004, 69 FR 33102	June 14, 2004, 69 FR 33102
Original Federal Register Notice	May 6, 1997, 62 FR 24588	June 7, 2000, 65 FR 36074	September 16, 1999, 64 FR 50393
Geographic Distribution	from Cape Blanco, Oregon, to Punta Gorda, California	from Redwood Creek (Humboldt County), south to the Gualala River, inclusive	from Redwood Creek (Humboldt County) south through the Russian River
Critical Habitat Designation	May 5, 1999, 64 FR 24049	N/A	N/A (vacated by consent decree April 30, 2002)

A. Critical Habitat

In designating critical habitat, NMFS considers the following requirements of the species: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for 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 [50 CFR 424.12(b)]. In addition to these factors, NMFS also focuses on the known physical and biological features (primary constituent elements) within the designated area that are essential to the conservation of the species and that may require special management considerations or protection. These essential features may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation.

Current condition of critical habitat for SONCC coho salmon at the ESU scale is described in the *Factors Responsible for the SONCC Coho Salmon Decline* section below. The *Environmental Baseline* section describes habitat conditions within the action area. Furthermore, the *Effects of the Action* section considers anticipated effects on fish habitat and how these effects affect the conservation value of critical habitat.

B. Species Life History and Population Trends

1. Coho Salmon

a. *General Life History*

In contrast to the life history patterns of other Pacific salmonids, coho salmon generally exhibit a relatively simple three-year life cycle. Most coho salmon enter rivers between September and February. Coho salmon river entry timing is influenced by many factors, one of which appears to be river flow. In addition, many small California stream systems have their mouths blocked by sandbars for most of the year except winter. In these systems, coho salmon and other Pacific salmonid species are unable to enter the rivers until sufficiently strong freshets open passages through the bars (Weitkamp *et al.* 1995). Coho salmon spawn from November to January (Hassler 1987), and occasionally into February and March (Weitkamp *et al.* 1995).

Although each native stock appears to have a unique time and temperature for spawning that theoretically maximizes offspring survival, coho salmon generally spawn at water temperatures within the range of 10-12.8°C (Bell 1991). Bjornn and Reiser (1991) found that spawning occurs in a few third-order streams, but most spawning activity was found in fourth- and fifth-order streams. Nickelson *et al.* (1992) found that spawning occurs in tributary streams with a gradient of 3% or less. Spawning occurs in clean gravel ranging in size from that of a pea to that of an orange (Nickelson *et al.* 1992). Spawning is concentrated in riffles or in gravel deposits at the downstream end of pools featuring suitable water depth and velocity (Weitkamp *et al.* 1995).

The favorable range for coho salmon egg incubation is 10-12.8°C (Bell 1991). Coho salmon eggs incubate for approximately 35 to 50 days, and start emerging from the gravel two to three weeks after hatching (Hassler 1987; Nickelson *et al.* 1992). Following emergence, fry move into shallow areas near the stream banks. As coho salmon fry grow, they disperse upstream and downstream to establish and defend territories (Hassler 1987).

Juvenile rearing usually occurs in tributary streams with a gradient of 3% or less, although they may move up to streams of 4% or 5% gradient. Juveniles have been found in streams as small as one to two meters wide. At a length of 38-45 mm, the fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Godfrey 1965, Nickelson *et al.* 1992). Rearing requires temperatures of 20°C or less, preferably 11.7-14.4°C (Reiser and Bjornn 1979, Reeves *et al.* 1987, Bell 1991). Coho salmon fry are most abundant in backwater pools during spring. During the summer, coho salmon fry prefer pools featuring adequate cover such as large woody debris, undercut banks, and overhanging vegetation. Juvenile coho salmon prefer to over-winter in large mainstem pools, backwater areas and secondary pools with large woody debris, and undercut bank areas (Heifetz *et al.* 1986, Hassler 1987). Coho salmon rear in fresh water for up to 15 months, then migrate to the sea as smolts between March and June (Weitkamp *et al.* 1995).

The ideal food channel for maximum coho smolt production would have shallow depth (7-60 cm), fairly swift mid-stream flows (60 cm/sec), numerous marginal back-eddies, narrow width (3-6 cm), copious overhanging mixed vegetation (to lower water temperatures, provide leaf-fall, and contribute terrestrial insects), and banks permitting hiding places (Boussu 1954). The early diets of emerging fry include chironomid larvae and pupae (Mundie 1969). Juvenile coho salmon are carnivorous opportunists that primarily eat aquatic and terrestrial insects. They do not appear to pick stationary items off the substratum (Mundie 1969, Sandercock 1991).

In preparation for their entry into a saline environment, juvenile salmon undergo physiological transformations known as smoltification that adapt them for their transition to salt water. These transformations include different swimming behavior and proficiency, lower swimming stamina, and increased buoyancy that also make the fish more likely to be passively transported by currents. In general, smoltification is timed to be completed as fish are near the fresh water to salt water transition. Too long a migration delay after the process begins is believed to cause the fish to miss the "biological window" of optimal physiological condition for the transition. Chinook salmon spend between one and four years in the ocean before returning to their natal streams to spawn (Myers *et al.* 1998).

Little is known about residence time or habitat use in estuaries during seaward migration, although it is usually assumed that coho salmon spend only a short time in the estuary before entering the ocean (Nickelson *et al.* 1992). Growth is very rapid once the smolts reach the estuary (Fisher *et al.* 1984). While living in the ocean, coho salmon remain closer to their river of origin than do Chinook salmon (Weitkamp *et al.* 1995). Nevertheless, coho salmon have been captured several hundred to several thousand kilometers away from their natal stream (Hassler 1987). After about 12 months at sea, coho salmon gradually migrate south and along the coast, but some appear to follow a counter-clockwise circuit in the Gulf of Alaska (Sandercock 1991). Coho salmon typically spend two growing seasons in the ocean before returning to their natal streams to spawn as three year-olds. Some precocious males, called "jacks," return to spawn after only six months at sea.

b. Range-wide Status and Trends of the SONCC Coho Salmon ESU

Available historical and recent published coho salmon abundance information are summarized in the NMFS coast-wide status review (Weitkamp *et al.* 1995). The following are excerpts from this document:

"Gold Ray Dam adult coho passage counts provide a long-term view of coho salmon abundance in the upper Rogue River. During the 1940s, counts averaged ca. 2,000 adult coho salmon per year. Between the late 1960s and early 1970s, adult counts averaged fewer than 200. During the late 1970s, dam counts increased, corresponding with returning coho salmon produced at Cole Rivers Hatchery. Coho salmon run size estimates derived from seine surveys at Huntley Park near the mouth of the Rogue River have ranged from ca. 450 to 19,200 naturally-produced adults between 1979 and 1991.

In Oregon south of Cape Blanco, Nehlsen *et al.* (1991) considered all but one coho salmon population to be at high risk of extinction. South of Cape Blanco, Nickelson *et al.* (1992) rated all Oregon coho salmon populations as depressed.

Brown and Moyle (1991) estimated that naturally-spawned adult coho salmon returning to California streams were less than 1% of their abundance at mid-century, and indigenous, wild coho salmon populations in California did not exceed 100 to 1,300 individuals. Further, they stated that 46% of California streams which historically supported coho salmon populations, and for which recent data were available, no longer supported runs.

No regular spawning escapement estimates exist for natural coho salmon in California streams. California Department of Fish and Game (CDFG 1994) summarized most information for the northern California region of this ESU. They concluded that "coho salmon in California, including hatchery populations, could be less than 6% of their abundance during the 1940s, and have experienced at least a 70% decline in the 1960s." Further, they reported that coho salmon populations have been virtually eliminated in many streams, and that adults are observed only every third year in some streams, suggesting that two of three brood cycles may already have been eliminated.

The rivers and tributaries in the California portion of this ESU were estimated to have average recent runs of 7,080 natural spawners and 17,156 hatchery returns, with 4,480 identified as "native" fish occurring in tributaries having little history of supplementation with non-native fish. Combining recent run-size estimates for the California portion of this ESU with Rogue River estimates provides a rough minimum run-size estimate for the entire ESU of about 10,000 natural fish and 20,000 hatchery fish."

Schiewe (1997a) summarized and updated new data on trends in abundance for coho salmon from the northern California and Oregon coasts. The following are excerpts from this document regarding the status and trends of the SONCC coho salmon ESU:

"Information on presence/absence of coho salmon in northern California streams has been updated since the study by Brown *et al.* (1994) cited in the status review. More recent data (Table 2) indicates that the proportion of streams with coho salmon present is lower than in the earlier study (52% vs. 63%). In addition, NMFS' Biological Review Team (BRT) received updated estimates of escapement at the Shasta and Willow Creek weirs in the Klamath River Basin, but these represent primarily hatchery production and are not useful in assessing the status of natural populations.

New data on presence/absence in northern California streams that historically supported coho salmon are even more disturbing than earlier results, indicating that a smaller percentage of streams in this ESU contain coho salmon compared to the percentage

presence in an earlier study. However, it is unclear whether these new data represent actual trends in local extinctions, or are biased by sampling effort.”

NMFS (2001a) updated the status review for coho salmon from the Central California Coast and the California portion of the SONCC ESUs. The following is excerpted from the updated status review:

“In the California portion of the SONCC coho salmon ESU, there appears to be a general decline in abundance, but trend data are more limited in this area and there is variability among streams and years. In the California portion of the SONCC coho salmon ESU, Trinity River Hatchery maintains large production and is thought to create significant straying to natural populations. In the California portion of the SONCC coho salmon ESU, the percent of streams with coho present in at least one brood year has shown a decline from 1989-1991 to the present. In 1989-1991 and 1992-1995, coho were found in over 80% of the streams surveyed. Since then, the percentage has declined to 69% in the most recent three-year interval.

Both the presence-absence and trend data presented in this report suggest that many coho salmon populations in this ESU continue to decline. Presence-absence information from the past 12 years indicates fish have been extirpated or at least reduced in numbers sufficiently to reduce the probability of detection in conventional surveys. Unlike the CCC ESU, the percentage of streams in which coho were documented did not experience a strong increase in the 1995-1997 period. Population trend data were less available in this ESU, nevertheless, for those sites that did have trend information, evidence suggests declines in abundance.

After considering this information, we conclude that the Southern Oregon/Northern California Coast ESU is presently not at risk of extinction, but it is likely to become endangered in the foreseeable future. The conclusion is tempered by the fact that population trend data was limited, and further analysis may reveal declines sufficient to conclude that the California portion of this ESU is in danger of extinction.”

Based on the very depressed status of current coho populations discussed above as well as insufficient regulatory mechanisms and conservation efforts over the ESU as a whole, NMFS (2003) concluded that the ESU is still likely to become endangered in the foreseeable future.

Table 2. Summary statistics of historical and current presence-absence data from the California portion of the SONCC coho salmon ESU (Schiewe 1997a).

Geographic Location	Number of streams historically inhabited by coho salmon	Number of streams recently surveyed	Number of streams with coho salmon present	Streams with coho salmon present	
				New data	Brown <i>et al.</i> (1994)
Del Norte County	130	46	21	46%	55%
Humboldt County	234	130	71	55%	69%
Total	364	176	92	52	63

2. NC Steelhead ESU

a. *General Life History*

Biologically, steelhead can be divided into two basic run-types, based on the state of sexual maturity at the time of river entry and duration of spawning migration (Burgner *et al.* 1992). The stream-maturing type, or summer steelhead, enters fresh water in a sexually immature condition and requires several months in freshwater to mature and spawn. The ocean-maturing type, or winter steelhead, enters fresh water with well-developed gonads and spawns shortly after river entry (Barnhart 1986). Variations in migration timing exist between populations. Some river basins (*e.g.*, Mad River) have both summer and winter steelhead, while others only have one run-type. South of Cape Blanco, Oregon, summer steelhead are known to occur in the Rogue, Smith, Klamath, Trinity, Mad, and Eel Rivers; and in Redwood Creek (Busby *et al.* 1996).

Summer steelhead enter fresh water between May and October in the Pacific Northwest (Nickelson *et al.* 1992; Busby *et al.* 1996). Steelhead require cool, deep holding pools during summer and fall, prior to spawning (Nickelson *et al.* 1992). They migrate inland toward spawning areas, overwinter in the larger rivers, resume migration in early spring to natal streams, and then spawn (Meehan and Bjornn 1991, Nickelson *et al.* 1992) in January and February (Barnhart 1986).

Winter-run steelhead enter fresh water between November and April in the Pacific Northwest (Nickelson *et al.* 1992, Busby *et al.* 1996), migrate to spawning areas, and then spawn, generally in April and May (Barnhart 1986). Some adults, however, do not enter some coastal streams until spring, just before spawning (Meehan and Bjornn 1991).

There is a high degree of overlap in spawn timing between populations within an ESU regardless of run type (Busby *et al.* 1996). Difficult field conditions at that time of year and the remoteness of spawning grounds contribute to the relative lack of specific information on steelhead spawning. 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 (Nickelson *et al.* 1992; August 9, 1996, 61 FR 41542). Iteroparity is more common among southern steelhead populations than northern populations (Busby *et al.* 1996).

Steelhead spawn in cool, clear streams featuring suitable gravel size, depth, and current velocity. Intermittent streams may be used for spawning (Everest 1973, Barnhart 1986). Steelhead enter streams and arrive at spawning grounds weeks or even months before they spawn and are vulnerable to disturbance and predation. Cover, in the form of overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water, turbulence, and turbidity (Giger 1973) reduce disturbance and predation of spawning steelhead. It appears that summer steelhead occur where habitat is not fully utilized by winter steelhead; summer steelhead usually spawn farther upstream than winter steelhead (Withler 1966, Behnke 1992).

Steelhead require a minimum depth of 0.18 m and a maximum velocity of 2.44 m/s for active upstream migration (Smith 1973). Spawning and initial rearing of juvenile steelhead generally take place in small, moderate-gradient (generally 3-5%) tributary streams (Nickelson *et al.* 1992). A minimum depth of 0.18 m, water velocity of 0.30-0.91 m/s (Smith 1973, Thompson 1972), and clean substrate 0.6-10.2 cm (Hunter 1973, Nickelson *et al.* 1992) are preferred for spawning. Steelhead spawn in water temperatures ranging from 3.9-9.4°C (Bell 1991).

Depending on water temperature, steelhead eggs may incubate for approximately 1.5-4 months before hatching, generally between February and June (Bell 1991). Bjornn and Reiser (1991) noted that steelhead eggs incubate about 85 days at 4°C and 26 days at 12°C to reach 50% hatch. Nickelson *et al.* (1992) stated that eggs hatch in 35-50 days, depending upon water temperature.

After two to three weeks, in late spring, and following yolk sac absorption, alevins emerge from the gravel and begin actively feeding. After emerging from the gravel, fry usually inhabit shallow water along stream margins (Nickelson *et al.* 1992). Older fry establish and defend territories. Steelhead summer rearing takes place primarily in the higher velocity areas of pools, although young-of-the-year are abundant in glides and riffles. Winter rearing occurs more uniformly at lower densities across a wide range of fast and slow habitat types. Productive steelhead habitat is characterized by complexity, primarily in the form of large and small in-

stream wood. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson *et al.* 1992).

Juvenile steelhead migrate little during their first summer and occupy a range of habitats featuring moderate to high water velocity and variable depths (Bisson *et al.* 1988). Rearing juveniles prefer water temperatures ranging from 12-15°C (Reeves *et al.* 1987). Juvenile steelhead feed on a wide variety of aquatic and terrestrial insects (Chapman and Bjornn 1969), and older juveniles sometimes prey on emerging fry. Steelhead hold territories close to the substratum where flows are lower and sometimes counter to the main stream; from these, they can make forays up into surface currents to take drifting food (Kalleberg 1958). Juvenile steelhead rear in freshwater from one to four years (usually two years in the California ESUs), then smolt and migrate to the ocean in March and April (Barnhart 1986). Winter steelhead populations generally smolt after two years in fresh water (Busby *et al.* 1996). Steelhead smolts are usually 15-20 cm total length and migrate to the ocean in the spring (Meehan and Bjornn 1991). Based on purse seine catch, juvenile steelhead tend to migrate directly offshore during their first summer from whatever point they enter the ocean rather than migrating along the coastal belt as salmon do. During the fall and winter, juvenile steelhead move southward and eastward (Hartt and Dell 1986).

Steelhead typically reside in marine waters for 2 or 3 years prior to returning to their natal stream to spawn as 4- or 5-year olds (August 9, 1996, 61 FR 41542). Populations in Oregon and California have higher frequencies of age-1 ocean steelhead than populations to the north, but age-2 ocean steelhead generally remain dominant (Busby *et al.* 1996). Age structure appears to be similar to other west coast steelhead, dominated by 4-year-old spawners (Busby *et al.* 1996). Some steelhead return to fresh water after only 2 to 4 months in the ocean and are termed "half-pounders" (Snyder 1925). Half-pounders generally spend the winter in fresh water and then out-migrate again the following spring for several months before returning to fresh water to spawn. Half-pounders occur over a relatively small geographic range in southern Oregon and northern California, and have only been reported in the Rogue, Klamath, Mad, and Eel Rivers (Snyder 1925, Kesner and Barnhart 1972, Everest 1973, Barnhart 1986).

b. Range-wide Status and Trends of NC Steelhead ESU

Available historical and recent published steelhead abundance are summarized in the NMFS west coast steelhead status review (Busby *et al.* 1996). The following are excerpts from this document:

“Prior to 1960, estimates of abundance specific to this ESU were available from dam counts in the upper Eel River (Cape Horn Dam—annual average of 4,400 adult steelhead in the 1930s), the South Fork Eel River (Benbow Dam—annual average of 19,000 adult steelhead in the 1940s), and the Mad River (Sweasey Dam—annual average of 3,800 adult steelhead in the 1940s).

In the mid-1960s, estimates of steelhead spawning populations for many rivers in this ESU totaled 198,000. The only current run-size estimates for this area are counts at Cape Horn Dam on the Eel River where an average of 115 total and 30 wild adults were reported.

Adequate adult escapement information was available to compute trends for seven stocks within this ESU. Of these, five data series exhibit declines and two exhibit increases during the available data series, with a range from 5.8 percent annual decline to 3.5 percent annual increase. Three of the declining trends were significantly different from zero. We have little information on the actual contribution of hatchery fish to natural spawning, and little information on present total run sizes for this ESU. However, given the preponderance of significant negative trends in the available data, there is concern that steelhead populations in this ESU may not be self-sustaining.”

Schiewe (1997b) summarized more recent data on trends in abundance for summer and winter steelhead in the Northern California ESU. The following are excerpts from this document:

“Updated spawner surveys of summer steelhead in Redwood Creek, the South Fork of the Van Duzen River (Eel River Basin), and the Mad River suggest mixed trends in abundance: the Van Duzen fish decreased by 7.1 percent from 1980-96 and the Mad River summer steelhead increased by 10.3 percent over the same time period. The contribution of hatchery fish to these trends in abundance is not known.

New weir counts of winter steelhead in Prairie Creek (Redwood Creek Basin, Humboldt County) show a dramatic increase (over 36 percent) in abundance during the period 1985-1992. This increase is difficult to interpret because a major highway construction project during this time resulted in intensive monitoring of salmonids in the basin and Prairie Creek Hatchery was funded to mitigate lost salmonid production. Therefore, it is unclear whether the increase in steelhead reflects increased monitoring and mitigation efforts or an actual recovery of Prairie Creek steelhead.”

In 2003, NMFS concluded that the status of NC steelhead had changed little since the 1997 evaluation. Based on this and a lack of implementation of State conservation measures, NMFS concluded that the NC steelhead ESU is likely to become endangered in the foreseeable future (NMFS 2003a).

3. CC Chinook Salmon ESU

a. General Life History

The coastal drainages south of Cape Blanco, Oregon, are dominated by the Rogue, Klamath, and Eel Rivers. The Chetco, Smith, Mad, Mattole, and Russian Rivers and Redwood Creek are smaller watersheds that contain sizable populations of fall-run Chinook salmon (Campbell and

Moyle 1990). Presently, spring-run Chinook salmon are found in the Rogue, Klamath, and Trinity Rivers; additionally, a vestigial spring-run may still exist on the Smith River (Campbell and Moyle 1990). Historically, fall-run Chinook salmon were predominant in most coastal river systems south to the Ventura River. However, their current distribution only extends to the Russian River (Healey 1991). There have also been recent spawning fall-run Chinook salmon reported in small rivers draining into San Francisco Bay (Nielsen *et al.* 1994).

Of the Pacific salmon, Chinook salmon exhibit arguably the most diverse and complex life history strategies. Healey and Heard (1986) described 16 age categories for Chinook salmon, 7 total ages with 3 possible freshwater ages. Two generalized freshwater life-history types were described by Healey (1991): "stream-type" Chinook salmon reside in freshwater for a year or more following emergence, whereas "ocean-type" Chinook salmon migrate to the ocean within their first year.

Chinook salmon mature between 2 and 6+ years of age (Myers *et al.* 1998). Freshwater entry and spawning timing are generally thought to be related to local water temperature and flow regimes (Miller and Brannon 1982). Runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and actual time of spawning (Myers *et al.* 1998).

Run timing for spring-run Chinook salmon typically begins in March and continues through July, with peak migration occurring in May and June. Spawning begins in late August and can continue through October, with a peak in September. Historically, spring-run spawning areas were located in the river headwaters. Run timing for fall-run Chinook salmon varies depending on the size of the river. Adult Rogue, Upper Klamath, and Eel River fall-run Chinook salmon return to freshwater in August and September and spawn in late October and early November (Stone 1897, Snyder 1931, Nicholas and Hankin 1988, Barnhart 1995). In other coastal rivers and the lower reaches of the Klamath River, fall-run freshwater entry begins later in October, with peak spawning in late November and December-often extending into January (Leidy and Leidy 1984, Nicholas and Hankin 1988, Barnhart 1995). Late-fall or "snow" Chinook salmon from Blue Creek, on the lower Klamath River, were described as resembling the fall-run fish from the Smith River in run and spawning timing, as well as the degree of sexual maturation at the time of river entry (Snyder 1931).

When they enter freshwater, spring-run Chinook salmon are immature and they must stage for several months before spawning. Their gonads mature during their summer holding period in freshwater. Over-summering adults require cold-water refuges such as deep pools to conserve energy for gamete production, redd construction, spawning, and redd guarding. The upper preferred water temperature for spawning adult Chinook salmon is 12-14°C (Reiser and Bjornn 1979). Unusual stream temperatures during spawning migration and adult holding periods can alter or delay migration timing, accelerate or retard maturation, and increase fish susceptibility to

diseases. Sustained water temperatures above 27°C are lethal to adult Chinook salmon (Cramer and Hammack 1952, CDFG 1998).

Spring-run Chinook salmon eggs generally incubate between October to January, and fall-run Chinook salmon eggs incubate between October and December (Bell 1991). Length of time required for eggs to develop and hatch is dependant on water temperature and is quite variable, typically ranging from 3-5 months. The optimum temperature range for Chinook salmon egg incubation is 6-12°C (Rich 1997). Incubating eggs show reduced egg viability and increased mortality at temperatures greater than 14°C and show 100% mortality for temperatures greater than 17°C (Velson 1987). Velson (1987) and Beacham and Murray (1990) found that developing Chinook salmon embryos exposed to water temperatures of 1.7°C or less before the eyed stage experienced 100% mortality. Emergence of spring- and fall-run Chinook salmon fry begins in December and continues into mid-April (Leidy and Leidy 1984, Bell 1991). Fry use woody debris, interstitial spaces in cobble substrates, and undercut banks as cover (Everest and Chapman 1972). As the fry grow, their habitat preferences change. Juveniles move away from stream margins and begin to use deeper water areas with slightly higher water velocities.

Post-emergent fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and aquatic crustaceans. As they grow to 50 to 75 mm in length, the juvenile salmon move out into deeper, swifter water, but continue to use available cover to minimize the risk of predation and reduce energy expenditure. The optimum temperature range for rearing Chinook salmon fry is 10°C to 13°C (Seymour 1956, Rich 1997) and for fingerlings is 13°C to 16°C (Rich 1997).

Chinook salmon populations south of Cape Blanco all exhibit an ocean-type life history. The majority of fish emigrate to the ocean as subyearlings, although yearling smolts can constitute up to approximately one-fifth of outmigrants from the Klamath River Basin, and to a lesser proportion in the Rogue River Basin. However, the proportion of fish which smolted as subyearling vs. yearling varies from year to year (Snyder 1931, Schluchter and Lichatowich 1977, Nicholas and Hankin 1988, Barnhart 1995). This fluctuation in age at smoltification is more characteristic of an ocean-type life history. Furthermore, the low flows, high temperatures, and barrier bars that develop in smaller coastal rivers during the summer months would favor an ocean-type (subyearling smolt) life history (Kostow 1995).

Ocean-type juveniles enter saltwater during one of three distinct phases. "Immediate" fry migrate to the ocean soon after yolk resorption at 30-45 mm in length (Lister *et al.* 1971, Healey 1991). In most river systems, however, fry migrants, which migrate at 50-150 days post-hatching, and fingerling migrants, which migrate in the late summer or autumn of their first year, represent the majority of ocean-type emigrants. Stream-type Chinook salmon migrate during their second or, more rarely, their third spring. Under natural conditions stream-type Chinook salmon appear to be unable to smolt as subyearlings.

The diet of out migrating ocean-type Chinook salmon varies geographically and seasonally, and feeding appears to be opportunistic (Healey 1991). Aquatic insect larvae and adults, *Daphnia*, amphipods (*Eogammarus* and *Corophium spp.*), and *Neomysis* have been identified as important food items (Kjelson *et al.* 1982, Healey 1991).

Juvenile stream- and ocean-type Chinook salmon have adapted to different ecological niches. Ocean-type Chinook salmon tend to utilize estuaries and coastal areas more extensively for juvenile rearing. In general, the smaller juveniles are at the time of emigration to the estuary, the longer they reside there (Kjelson *et al.* 1982, Levy and Northcote 1982, Healey 1991). Stream-type juveniles are much more dependent on freshwater stream ecosystems because of their extended residence in these areas. A stream-type life history may be adapted to those watersheds, or parts of watersheds, that are more consistently productive and less susceptible to dramatic changes in water flow, or which have environmental conditions that would severely limit the success of subyearling smolts (Miller and Brannon 1982, Healey 1991).

b. Range-wide Status and Trends of CC Chinook Salmon ESU

Available historical and most recent published Chinook salmon abundance information are summarized by Myers *et al.* (1998). The following are excerpts from this document:

“Estimated escapement of this ESU was estimated at 73,000 fish, predominantly in the Eel River (55,500) with smaller populations in; Redwood Creek, Mad River, Mattole River (5,000 each), Russian River (500), and several small streams in Del Norte and Humboldt counties.

Within this ESU, recent abundance data vary regionally. Dam counts of upstream migrants are available on the South Fork Eel River at Benbow Dam from 1938 to 1975. Counts at Cape Horn Dam, on the upper Eel River are available from the 1940s to the present, but they represent a small, highly variable portion of the run. No total escapement estimates are available for this ESU, although partial counts indicate that escapement in the Eel River exceeds 4,000.

Data available to assess trends in abundance are limited. Recent trends have been mixed, with predominantly strong negative trends in the Eel River Basin, and mostly upward trends elsewhere. Previous assessments of stocks within this ESU have identified several stocks as being at risk or of concern. Nehlsen *et al.* (1991) identified seven stocks as at high extinction risk and seven stocks as at moderate extinction risk. Higgins *et al.* (1992) provided a more detailed analysis of some of these stocks, and identified nine Chinook salmon stocks as at risk or of concern. Four of these stock assessments agreed with Nehlsen *et al.* (1991) designations, while five fall-run Chinook salmon stocks were either reassessed from a moderate risk of extinction to stocks of concern (Redwood Creek, Mad River, and Eel River) or were additions to the Nehlsen *et al.* (1991) list as stocks of special concern (Little and Bear rivers). In addition, two fall-run stocks (Smith and

Russian rivers) that Nehlsen *et al.* (1991) listed as at moderate extinction risk were deleted from the list of stocks at risk by Higgins *et al.* (1992), although USFWS reported that the deletion for the Russian River was due to a finding that the stock was extinct.”

NMFS (2003) concluded that this ESU is likely to become endangered in the foreseeable future. NMFS (2003) was concerned by continued evidence of low population sizes relative to historical abundance and mixed trends in the few time series of abundance indices available for analysis, and by the low abundances and potential extirpations of populations in the southern part of the ESU.

4. Factors Affecting the Species and Critical Habitat

Salmonids on the west coast of the United States have experienced declines in abundance in the past several decades as a result of loss, damage or change to their natural environment. Studies indicate that in most western states, about 80 to 90 percent of the historic riparian habitat has been eliminated (Norse 1990, California State Lands Commission 1993). Loss of habitat complexity and habitat fragmentation have also contributed to the decline of salmonids. For example, in national forests within the range of the northern spotted owl in western and eastern Washington, there has been a 58 percent reduction in large, deep pools due to sedimentation and loss of pool-forming structures such as boulders and large wood (FEMAT 1993). Similar or greater effects are likely in California. The California Advisory Committee on Salmon and Steelhead Trout (CACSSST) reported habitat blockages and fragmentation, logging and agricultural activities, urbanization, and water withdrawals as the most predominant problems for anadromous salmonids in California's coastal basins (CACSSST 1988). They identified associated habitat problems for each major river system in California. CDFG (1965b) reported that the most vital habitat factor for coastal California streams was “degradation due to improper logging followed by massive siltation, log jams, *etc.*” They cited road building as another cause of siltation in some areas. They identified a variety of specific critical habitat problems in individual basins, including extremes of natural flows (Redwood Creek and Eel River), logging practices (Mad, Eel, Mattole, Ten Mile, Noyo, Big, Navarro, Garcia, and Gualala Rivers), and dams with no passage facilities (Eel and Russian Rivers), and water diversions (Eel and Russian Rivers).

The factors for decline among populations of SONCC coho salmon, CC Chinook salmon, and NC steelhead are similar and are discussed collectively below. Factors affecting only a particular species are highlighted, where appropriate. For more detailed discussions on factors for decline of SONCC coho salmon, refer to Weitkamp *et al.* (1995) as updated by Schiewe (1997a) and CDFG (2002). Additionally, Lestelle *et al.* (1995) analysis of coho salmon habitat usage, general migratory patterns of life stages, environmental factors, and potential mechanisms of mortality reveals the habitat requirements of coho salmon by life-stage (Table 3). Factors influencing CC Chinook salmon are discussed by Myers *et al.* (1998). Factors causing NC Steelhead declines are described by Busby *et al.* (1996).

Table 3. Summary of environmental factors affecting freshwater habitat capacity and related density-independent survival by life stage of coho salmon, potential mechanisms of mortality, and habitat requirements (Lestelle *et al.* 1995).

Life Stage	Factors affecting population productivity	Potential mechanisms affecting survival	Habitat requirements
Egg to emergent fry	Substrate stability, amount of fine sediment in spawning gravels, spawning gravel permeability, water temperature, peak flows	High flow events cause loss of eggs due to streambed scour and shifting (Tagart 1984); reduced flow and DO levels to eggs due to high sedimentation cause increased mortality (Tagart 1984); high fine sediment levels cause entombment of fry (Phillips <i>et al.</i> 1975); increased temperatures advance emergence timing, thereby affecting survival in next life stage (Holtby 1988); anchor ice reduces water exchange in redds causing low DO levels and/or eggs to freeze (Bjornn and Reiser 1991).	<ul style="list-style-type: none"> - Relatively stable substrate - Low amount of fine sediment in spawning gravels - Low substrate embeddedness - Appropriate water temperatures and peak flow timing
Emergent fry to September parr	Flow dynamics during emergence period, stream gradient, number of sites suitable for fry colonization, predators, temperature ¹ , nutrient loading ¹	Loss of emergent fry occurs due to being displaced downstream by high flows (Holtby 1988); advanced emergence timing causes fry to encounter higher flows (Holtby 1988); high gradient and lack of suitable colonization sites for emergent fry cause fry to move downstream increasing risk of predation (Au 1972, Bjornn and Reiser 1991); stranding and death due to dewatering (Bottom <i>et al.</i> 1985); loss to predators (McFadden 1969); excessive temperatures promote disease and cause mortality (Bjornn and Reiser 1991); temperature and nutrient changes affect growth thereby affecting other causes of density-independent loss (Bjornn and Reiser 1991, Hicks <i>et al.</i> 1991).	<ul style="list-style-type: none"> - Suitable colonization habitat - Low predation - Appropriate flow dynamics - Appropriate nutrient loading
September parr to smolt	Fall and winter flows, number of accessible winter refuge sites, temperature, predators	Displacement during high flows (Scarlett and Cederholm 1984); stranding and death due to dewatering (Bottom <i>et al.</i> 1985, Cederholm <i>et al.</i> 1988); loss to predators (Zarnowitz and Raedeke 1984); loss due to poor health associated with winter conditions (Hartman and Scrivener 1990) ¹	<ul style="list-style-type: none"> - Suitable winter refuge habitat - Appropriate fall and winter flows and temperatures - Low predation

¹ Effects likely have both density-independent and dependent components.

a. Timber harvest

Timber harvest and associated activities occur over a large portion of the ESUs 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 riparian vegetation has been removed, reducing future sources of large woody debris (LWD) needed to form and maintain stream habitat that salmonids depend on for various life stages. Cumulatively, the increased sediment delivery and reduced woody debris supply have led to widespread impacts to 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 which reduces the ability of juvenile fish to feed, and, in some cases may cause physical harm by abrading the gills of individual fish. These changes in habitat have led to widespread decreases in the carrying capacity of the streams that support salmonids.

b. Road construction

Road construction, whether associated with timber harvest or other activities, has caused widespread impacts to salmonids (Furniss *et al.* 1991). Where roads cross salmonid-bearing streams, improperly placed culverts have blocked access to many stream reaches. Landsliding 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 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. These effects are similar to those described for timber harvest above.

c. Hatcheries

Artificial propagation is also a factor in the decline of salmonids due to the genetic impacts on indigenous, naturally-reproducing populations, disease transmission, predation of wild fish, depletion of wild stock to enhance brood stock, and replacement rather than supplementation of wild stocks through competition and the continued annual introduction of hatchery fish. Artificial propagation and other human activities, such as harvest and habitat modification, can genetically change natural populations so much that they no longer represent an evolutionarily significant component of the biological species (Waples 1991). NMFS specifically identified the past practices of the Mad River Hatchery as potentially damaging to NC Steelhead. CDFG out-planted non-indigenous Mad River Hatchery brood stocks to other streams within the ESU. They also attempted to cultivate a run of non-indigenous summer steelhead within the Mad River. CDFG ended these practices in 1996.

d. Water diversions

Streamflow 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 streamflows due to diversions reduces the amount of habitat available to salmonids and can degrade existing water quality, particularly where return flows enter the river. Reductions in the quantity of water in a given stream reach will reduce the carrying capacity of the reach. Where warm return flows enter the stream, fish may seek reaches with cooler water, thus increasing competitive pressures in other areas.

e. Predation

Predation was not believed to have been a major cause in the species decline, however, predators may have had substantial impacts in local areas. For example, Higgins *et al.* (1992) and CDFG (1994) reported that Sacramento River pikeminnow have been found in the Eel River basin and are considered a major threat to native salmonids (this is discussed further in the *Environmental Baseline* section). Furthermore, California sea lions and Pacific harbor seals, which occur in most estuaries and rivers where salmonid runs occur on the west coast, are known predators of salmonids. However, salmonids appear to be a minor component of the diet of marine mammals (Scheffer and Sperry 1931, Jameson and Kenyon 1977, Graybill 1981, Brown and Mate 1983, Roffe and Mate 1984, Hanson 1993). In the final rule listing the SONCC coho salmon ESU, for example, NMFS indicated that it was unlikely that pinniped predation was a significant factor in the decline of coho salmon on the west coast, although they may be a threat to existing depressed local populations. NMFS (1997) determined that although pinniped predation did not cause the decline of salmonid populations, in localized areas where they co-occur with salmonids (especially where salmonids concentrate or passage may be constricted), predation may preclude recovery of these populations. Specific areas where predation may preclude recovery cannot be determined without extensive studies.

f. Disease

Infectious disease is one of many factors that can influence adult and juvenile salmonid survival. Salmonids are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment. Very little current or historical information exists to quantify changes in infection levels and mortality rates attributable to these diseases for salmonids. However, studies suggest that naturally spawned fish tend to be less susceptible to pathogens than hatchery-reared fish (Sanders *et al.* 1992).

g. Existing regulatory mechanisms

Existing regulatory mechanisms, including land management plans (*e.g.*, National Forest Land Management Plans, State Forest Practice Rules), Clean Water Act section 404 activities, urban growth management, and harvest and hatchery management all contributed in varying degrees to

the decline of salmonids due to lack of protective measures, the inadequacy of existing measures to protect salmonids and/or their habitat, or the failure to carry out established protective measures.

The Clean Water Act (CWA), enforced in part by the U. S. Environmental Protection Agency (EPA), is intended to protect beneficial uses, including fishery resources. To date, implementation has not been effective in adequately protecting fishery resources, particularly with respect to non-point sources of pollution. In addition, section 404 of the CWA does not adequately address the cumulative and additive effects of loss of habitat through continued development of waterfront, riverine, coastal, and wetland properties that also contribute to the degradation and loss of important aquatic ecosystem components necessary to maintain the functional integrity of these habitat features. Sections 303 (d)(1)(C) and (D) of the CWA require States to prepare Total Maximum Daily Loads (TMDLs) for all water bodies that do not meet State water quality standards. Development of TMDLs is a method for quantitative assessment of environmental problems in a watershed and identification of pollution reductions needed to protect drinking water, aquatic life, recreation, and other uses of rivers, lakes, and streams. Appropriately protective aquatic life criteria are critical to the TMDL process for affecting the recovery of salmonid populations, as the criteria's exceedence will determine which water bodies will engage in the TMDL process and criteria compliance goals are the impetus for developing mass loading strategies. The ability of these TMDLs to protect salmonids should be significant in the long term. However, developing them quickly in the short term will be difficult, and their efficacy in protecting salmonid habitat will be unknown for years to come.

In August, 2002 the California Fish and Game Commission (Commission) issued a finding that coho salmon warranted listing as a threatened species in the Southern Oregon/Northern California Coast ESU under the California Endangered Species Act. The Commission directed the Department of Fish and Game to develop a Recovery Strategy. Subsequently, the Director of the Department of Fish and Game initiated a multi-stakeholder statewide Coho Recovery Team to make recommendations on components of a plan to recover the species. Once officially listed by the State, implementation of the recovery plan and protective regulations will potentially have significant long-term benefits to coho salmon. However, we do not know the manner in which additional regulations and recovery actions will be implemented. Therefore, at this time, we cannot estimate how coho salmon will benefit from the State listing.

h. Sport and commercial harvest

Over-fishing in non-tribal fisheries is believed to have been a significant factor (62 FR 24588) in the decline of salmonids. Further, NMFS notes that under some circumstances, the impacts of recreational freshwater fishing is of concern, particularly during years of decreased availability of refugia, such as drought years.

Commercial and recreational ocean salmon fisheries result in adult mortality of listed Chinook salmon and coho salmon originating from the action area. Steelhead are rarely caught in the

ocean fisheries. Ocean salmon fisheries are managed by NMFS to achieve Federal conservation goals for certain key stocks specified in the fishery management plan (FMP) for west coast salmon, the Pacific Coast Salmon Plan. The goals specify 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 section 7 consultations that NMFS conducts. The key stocks in California are Klamath and Sacramento River fall-run Chinook salmon. The commercial and recreational take of listed salmon originating from the Eel River is treated as incidental to the harvest of more abundant Chinook salmon stocks from the Central Valley and Klamath basins. In the past, NMFS has issued Reasonable and Prudent Alternatives (RPAs) in connection with the ocean harvest of several listed salmon populations, including CC Chinook salmon and SONCC coho salmon, both of which occur in the action area.

Estimates of harvest rates based on tagged Chinook salmon originating from the action area are not available. However, reliable harvest rates are available for Klamath River fall-run Chinook salmon, which are not part of the CC Chinook salmon ESU but have a pattern of ocean distribution similar to that of Eel River Chinook salmon, as described in the 2000 FMP Opinion. Beginning in 1991, ocean harvest rates on Klamath River fall-run Chinook salmon declined from an average of 0.45 (1981-1990) to an average of 0.12 (1991-2002). Harvest rates are expressed as the proportion of adults in a given year class that are caught. The reduction in ocean harvest was a result of implementing the Federally reserved fishing rights of the Yurok and Hoopa Valley Indian tribes of the Klamath Basin, quantified in 1993 as 50% of the available harvest. NMFS' 2000 biological opinion on the FMP require that ocean harvest rates on Klamath River fall-run Chinook salmon (used as an indicator for harvest rates on CC Chinook salmon) not exceed 0.16.

NMFS is also concerned with the potential mortality of CC Chinook salmon as a result of catch and release angling that occurs in the action area during the fall. Despite restrictions on the retention of Chinook salmon once they enter freshwater, a catch and release fishery for Chinook salmon remains popular; especially in the action area (J. Froland, CDFG, pers. comm. 2002; M. Gilroy, CDFG, pers. comm. 2002). No analysis of the effects of this fishery on CC Chinook salmon has been undertaken and the amount of death or injury is unknown. However, it is likely that this fishery results in a decrease in the number of adult CC Chinook salmon that survive to spawn once they enter freshwater.

Ocean exploitation rate estimates are available for tagged hatchery coho salmon from the Klamath, Trinity, and Rogue Rivers and serve as an index for the impact rates on SONCC coho salmon. NMFS' 1999 FMP biological opinion requires that management measures developed under the FMP achieve an ocean exploitation rate on Rogue/Klamath hatchery coho salmon stocks of no more than 0.13. Retention of either marked or unmarked coho salmon is prohibited off California. Post-season estimates of exploitation rates on Rogue/Hatchery stocks have been below the required 0.13 since 1998.

Further discussion of the impacts of sport and commercial harvest is provided in the *Environmental Baseline* section.

VI. ENVIRONMENTAL BASELINE

The environmental baseline is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species within the action area. The environmental baseline “includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process” (50 CFR § 402.02).

There are numerous anthropogenic factors that have contributed to the degraded conditions and ecological stress currently exhibited by aquatic ecosystems. Among the factors that are directly relevant to Pacific salmonids are: loss of large wood recruitment (from riparian habitat degradation and harvest removal); water quality degradation, especially temperature and sedimentation parameters (from timber harvest and road construction); and altered streamflows (changes in the timing, magnitude, duration and spatial distribution of peak and low flows). These factors have reduced habitat complexity, for example, loss of pools and off-channel habitats, and in turn impaired the survivability of salmonids that rely on these habitats for shelter, rearing and spawning.

More specific discussion of these factors is provided in the section that discusses conditions within the action area. Additional factors influencing salmonids and critical habitat are discussed in the *Effects of the Action* section.

The Environmental Baseline first describes current and historic impacts to salmonids and their habitat throughout the action area. This discussion includes a description of habitat condition, salmonid trends, abundance and utilization of the Mad River basin. Next, factors limiting the survival and recovery of ESA-listed salmonids in the action area are described. This final step recognizes that there are some factors that may be unique to a river reach, yet continue to limit the survival and recovery of a particular species at the ESU-scale.

A. Mad River Baseline

1. Watershed Description

a. *Geology*

The Mad River Basin is within the Coast Range Geologic Province. Bedrock is composed mostly of Central Belt Franciscan Complex and Quaternary - Tertiary Overlap deposits, juxtaposed by the Mad River thrust fault system. Topography is relatively steep and mountainous, but fairly extensive lowlands are present from the mouth and upstream to the Mad River Hatchery, near the

town of Blue Lake.

Fluvial terrace deposits cover the bedrock at various locations adjacent to the present stream and river channels, but at higher levels than the active channel deposits. As many as six separate terrace levels have been identified at some locations, with progressively older terrace deposits at correspondingly higher levels. These deposits are composed of unconsolidated, poorly sorted sands, gravels and boulder conglomerates. Fluvial terrace deposits are most extensive adjacent to Lindsay Creek in the Fieldbrook area and adjacent to the Mad River at Blue Lake and Butler Valley (Kelley 1984, Kilbourne 1983-85).

The construction of two dams, and the later removal of one of them, has modified the sediment migration pattern in the Mad River system. Sweasey Dam was constructed about seven miles upstream from Blue Lake in 1938. By 1960, its 3,000 acre-foot reservoir was nearly filled with gravel, sand and silt. The dam was removed in 1970, releasing the sediment (almost 5 million cubic yards) for subsequent movement downstream. That pulse of material is still affecting the river channel below the dam site. Robert Matthews Dam at Ruth Reservoir was constructed in 1961, with a capacity of 51,800 acre-feet. Sediment is accumulating in the reservoir at a low rate because of its location in the upper watershed where the sediment load is relatively low (James 1982).

Published geologic maps indicate that both shallow and deep-seated landslides exist throughout the watershed. Deep-seated rotational/translational landslides and earthflows are common in the Franciscan melange. Younger bedrock in the area is highly erodible and susceptible to slumping and rotational movement.

b. Climate

The watershed's precipitation is affected by its proximity to the Pacific Ocean and its altitude, with annual average precipitation of 40 inches in the lower zone, and an average of 80 inches in the middle zone. Snow is common above 4,000 feet on the eastern ridgeline, with average annual snowfall of one to five feet. The Mad River has two distinct seasons (dry and wet), and from June through October, coastal fog moderates ambient air and water temperatures in the lower zone.

The annual average water yield from the Mad River is approximately 1 million-acre feet. Natural flow in the Mad River varies greatly; 85% of the water yield or discharge occurs from November through March. Severe storms periodically cause widespread flooding and channel adjustment. The four largest recorded flood events were in January 1953, December 1955, November 1960, and December 1964. The highest recorded peak discharge was during the 1955 event: 77,800 cfs at the Arcata gauge station (Simpson 2002).

c. Vegetation

A general description of vegetation in the Mad River Basin is provided in Simpson (2002):

“The Mad River basin extends inland from the coast approximately 26 miles and reaches an elevation of 5200 feet. It encompasses a range of vegetative types from coastal scrub and Sitka spruce forest in the coastal area to Douglas-fir/white fir forests at elevations above 4000 feet in the extreme southeastern corner.

Redwood/Douglas-fir forests dominate roughly the lower two-thirds of the Mad River Basin. This type of forest also includes occasional grand fir, western red cedar, and western hemlock on lower slopes near the coast. Red alder is the most common hardwood in riparian zones, and tan oak is the most common mid to upper slope hardwood, with Pacific madrone occurring as a minor stand component on drier sites. As distance from the coast and elevation increase, the proportion of redwood in stands decreases and Douglas-fir and tannic become more prevalent, with these species dominating the landscape at elevations above 2000 feet. Occasional incense cedar is also found at higher elevations along the watershed’s western boundary.

Extensive prairies are particularly distinctive features on south to west slopes and ridgetops in the upper one-third of the basin. In this area California black oak forms nearly pure stands as an ecotone between prairies and Douglas-fir forest.

Timber harvesting in the Mad River Basin began in the late 1800s near the coast as white settlers arrived. By 1930 almost all of the redwood type had been harvested. The Douglas-fir dominated forests in the upper reaches were not extensively logged until the 1940s, and by 1970 very little timberland remained in the watershed that had not been logged. Harvesting of mature second-growth forests was initiated in the lower reaches of the watershed in the 1960s.”

d. Channel Morphology

Historically, the lower Mad River would flood through multiple floodplain/slough channels to Humboldt Bay. As a result, the Mad River infrequently flushed its estuary of accumulated sediments, and according to historical accounts from 1870 to 1915, the mouth of the Mad River was often closed during the low-flow period of October, November, and December. Local fishermen would artificially breach the sand bar, primarily to allow salmon to migrate into the river. Since the early 1900s, the lower Mad River has been channelized and straightened; its overflow channels have been sealed, its banks armored, and now most moderate floods remain confined in the lower Mad River channel (Scalici 1993). Degradation to the stream channel of the lower Mad River is one consequence of concentrating flood flows in the main channel. Also, its tidal prism and estuary have expanded, and currently the lower 4.4 miles of the Mad River, up to Highway 101, are tidally influenced. From 1975 to 1998, the mouth of the Mad River migrated

north along the coastal bluffs, greatly elongating its estuary area, but in 1998, the mouth began to return south, reducing its estuary area. The estuary and the tidal portion of the Mad River lack adjoining tidelands or tidal sloughs, which serve as important rearing habitat for anadromous salmonids, particularly for Chinook salmon.

e. Anadromous Reach

Geomorphically, and for purposes of anadromous salmonid distribution, the Mad River can be stratified into four distinct zones: (1) estuary; (2) lower zone, estuary to RM 34; (3) middle zone, RM 34-61; and (4) upper zone, RM 61 and above. Anadromous salmonids inhabit the estuary and lower river zone and its tributaries; the middle river zone can be characterized as a geologically unstable and steep (between Wilson Creek RM 45.5 and Bug Creek RM 49, the river drops 600 feet in elevation). In the middle river zone, depending on local conditions and flow, the boulder canyon contains barriers at RM 45, 49, and 53. These barriers inhibit anadromous salmonid migration to the upper river zone. Presently, Pilot Creek at RM 60.7 contains an intermittent run of steelhead when conditions allow fish passage through boulder fields that hinder migration. Under natural conditions, prior to the construction of Matthews Dam, the upper zone often had no flow in August or September.

Six tributaries of the Mad River are utilized by anadromous salmonids for spawning:

- RM 10.8 Lindsay Creek, drainage area 17 square miles;
- RM 14.8 North Fork, drainage area 50 square miles;
- RM 20.6 Cañon Creek, drainage area 16 square miles;
- RM 32.1 Maple Creek, drainage area 17 square miles;
- RM 33.4 Boulder Creek, drainage area 19 square miles; and
- RM 60.7 Pilot Creek, drainage area 40 square miles

2. Watershed Condition

a. Hydrology

Flows within the mainstem Mad River are influenced by releases from Matthews Dam located 84 miles upstream from the mouth. Matthews Dam and its impoundment, Ruth Reservoir, supply water to the District diversion facilities. The dominant effects of the impoundment are an augmentation of natural stream flows below the dam during the summer and fall low-flow periods, and elimination of sediment transport from the upper watershed to the middle and lower portions. During winter storms, the reservoir fills rapidly and flows over the spillway. Therefore, the existence of the dam does not have a large effect on peak flood flows but does cause the reservoir to serve as a bedload trap for sediments generated in the upper watershed.

b. Woody Debris

Large woody debris (LWD) survey results for reaches in three tributaries (Lindsay Creek, Cañon Creek and Dry Creek) indicate low amounts of LWD and size of existing LWD tends to be small (primarily 1'-2' diameter pieces, Simpson 2002). Further, due to past logging practices and development along streams, many riparian zones tend to be dominated by alder, willow and younger conifers (Simpson 2002). Given the current vegetation age structure and past logging history along streams, recruitment of adequately sized woody debris to many of the stream reaches is not likely to occur for several decades.

c. Turbidity and Fine Sediment

The Mad River watershed is CWA section 303(d) listed for turbidity (EPA 1998). Principal contributors of fine sediment are hydrologically connected road segments. Simpson (2002) estimated that the average extent of hydrologically connected roads in the watershed is 30%. For Green Diamond Resource Company (formerly Simpson Resource Company) roads within the Mad River basin, this value equates to approximately 130 miles of roads that are hydrologically connected and capable of delivering road-generated sediment to the streams.

d. Stream Temperature

Water temperatures within the lower Mad River demonstrate a cooling trend from upper river areas; however, according to Jensen (2000), the “general water temperature range in the lower Mad River was (64-71°F) [18-22°C], and the maximum sustained temperatures were in the range of (71-73°F) [22-24°C].”

For tributaries to the Mad River, Green Diamond Resource Company collected data for 31 sites in class I and II streams. A total of 90 summer temperature profiles ranged from a low of 11.6°C to a high of 18.8°C, with the highest temperatures typically in Cañon Creek (Simpson 2002).

3. Historic and Current Impacts to Salmonids Within the Mad River

a. Artificial Propagation

Mad River Hatchery, located at RM 17, was opened in 1970. Chinook salmon, coho salmon and steelhead were produced. Chinook salmon broodstock has generally been drawn from fish returning to the Mad River, however, releases in the 1970s and 1980s included substantial releases of fish from out-of-basin and out-of-ESU (NMFS 2003a). Coho salmon production ceased after the 1999 brood year. The original broodstock was from the Noyo River, which lies outside of the SONCC coho salmon ESU. Concern about both out-of-ESU and out-of-basin stock transfers, as late as 1996, was sufficiently great that the Mad River Hatchery was excluded from the SONCC ESU by NMFS (Schiewe 1997a).

In recent years, steelhead continued to be produced in large numbers at the Mad River Hatchery. An average of 5,536 adults were trapped annually from 1991 to 2002 (NMFS 2003a). Original broodstock was supplied from the Eel River with additional transfers from the San Lorenzo River (NMFS 2003a). Summer-run steelhead stocks have also been introduced into the Mad River Basin. Therefore, steelhead stocks in the Mad River currently possess an out-of-basin genetic component and are subject to the effects of hatcheries described in the *Status of the Species* section (e.g., (1) carrying capacity impacts, (2) competition, (3) predation, and (4) altered migration behavior). Due to funding shortfalls in the CDFG budget, continued operation at Mad River Hatchery may cease. If outside funding sources are not secured, hatchery operations and production are likely to be reduced.

b. Floods

Major floods in 1955 and 1964 occurred during a period of intense land use, primarily related to timber harvest (CDFG 1997), which resulted in major adverse changes to the quantity and quality of salmonid habitat across the action area. Changes to spawning and rearing habitat, as a result of the floods, in combination with overfishing and poor ocean conditions, caused a decline in the Chinook salmon population from which they never recovered (Moyle 2002). In particular, the Eel and Van Duzen Rivers are likely still recovering from these past events. However, NMFS is not aware of any information that describes the progress of this recovery. In the action area, legacy effects that likely persist are widened and aggraded channels due to the immense quantity of sediment that was deposited in the reach during the floods. This material will likely continue to limit the formation of higher quality habitat until mature vegetation re-establishes on the deposited materials or the material is transported downstream.

c. Timber Harvest

Both the Mad River and North Fork Mad River have experienced a long history of timber harvest. A small portion of this watershed is owned and managed by the Pacific Lumber Company (PALCO). In 1999, PALCO began operating under a Habitat Conservation Plan for a term of 50 years. The PALCO HCP and associated Incidental Take Permit (ITP) provides State and Federal incidental take coverage for various aquatic and terrestrial species, including salmonids. The HCP and ITP provide coverage for timber harvest and related activities such as road construction. The objective of the HCP is to achieve, over time, properly functioning conditions as defined in the HCP. In order to achieve these goals and provide operational flexibility, the HCP relies upon watershed analysis to adjust interim conservation measures to achieve these goals according to site-specific conditions. Watershed analysis provides a mechanism for modifying riparian buffer widths, hillslope management prescriptions, channel migration zone prescriptions and monitoring. NMFS anticipates that the PALCO watershed analysis in the Mad River watershed will focus on Blue Slide and Black Creeks, where the bulk of PALCO's ownership lies. For non-PALCO lands in the analysis areas, the process is less rigorous, simply providing a coarse overview of watershed processes.

Woody Debris. Data by Simpson (2002) show that almost half (49%) of the vegetation in the lower portions of the Mad River watershed is less than 40 years old with no timber greater than 100 years old. We do not know how well this age distribution reflects conditions within the riparian zones or across the entire watershed. Canopy coverage for 18 miles of two surveyed streams, North Fork Mad River and Long Prairie Creek, was 73% and 95%, respectively, with the amount of deciduous vegetation composing 95% and 87%, respectively (Simpson 2002).

LWD survey results for reaches in three tributaries (Lindsay Creek; Creek and Dry Creek) are presented in Simpson 2002. In general, the surveys indicate low amounts of LWD and existing size of LWD tends to be small (primarily 1'-2' diameter pieces). Further, due to past logging practices and development along streams, many riparian zones tend to be dominated by alder, willow and younger conifers (Simpson 2002). Given the current vegetation age structure and past logging history along streams, recruitment of adequately sized woody debris to many of the stream reaches in the watershed is not likely to occur for several decades.

Sediment. Mass wasting occurs throughout the watershed and is a principal determinant of habitat condition. Deep-seated landslides are also present, particularly in the upper portions, where they contribute large amounts of sediment to the mainstem Mad River and tributaries.

The Mad River watershed is 303(d) listed for turbidity and sedimentation due to silviculture, resource extraction and non-point sources. A principal contributor of fine sediment are hydrologically connected road segments. Simpson (2002) estimated that the average extent of hydrologically connected roads in an area is 30%. For Simpson roads within the lower watershed, this value equates to approximately 130 miles of roads that are hydrologically connected and capable of delivering road-generated sediment to the stream network.

Hydrologic regime. Little is known on the magnitude of changes that have occurred to the natural hydrologic regime in the Mad River. The discussion on roads and stream diversions suggests that hillslope runoff may be delivered more efficiently to receiving stream channels via gullies, roadside ditches and skid trails. Therefore, streams may respond quicker to storm events; rising and falling much faster than in undisturbed conditions. Although this may have implications for the nature of sediment transport in the Mad River and tributaries, we cannot determine the specific effects this may have had on habitat conditions for salmonids. One possible effect is increased scour of redds as peak flows are increased due to management activities and legacy roads. Therefore, streambeds may scour more frequently and to greater depths than under normal conditions. However, analysis conducted on Freshwater Creek in the nearby Humboldt Bay watershed examining the effects of increased streamflows on redd scour suggests that the magnitude of peak flow increases expected in a managed watershed is not sufficient to change the overall scour and fill at redds relative to natural conditions (PALCO 2001).

Stream temperatures. Simpson currently monitors water temperature at 24 sites within class I and II streams. Highest temperatures, however, have been recorded in the lower mainstem reaches. The seven day moving average temperature for all recorded temperatures (52 summer profiles)

ranged from 12.0°C to 19.7°C.

Water temperatures within the lower Mad River demonstrate a cooling trend from upper river areas; however, according to Jensen (2000), the “general water temperature range in the lower Mad River was 18-22°C (64-71°F), and the maximum sustained temperatures were in the range of 22-24°C (71-73°C).”

For tributaries to the Mad River, Simpson has collected data for 31 sites in class I and II streams for up to and including the year 2000. A total of 90 summer temperature profiles range from a low of 11.6°C to a high of 18.8°C. Highest temperatures are typically seen in Cañon Creek.

d. Historic and Current Salmonid Fishery

In-river sport angling occurs on the Mad River. With the exception of hatchery steelhead, all salmonids must be released back into the river unharmed. This requirement is coupled with restrictions on gear (*e.g.*, barbless hooks). Due to the abundance of hatchery fish on the Mad River, angling pressure is often high, and wild fish may be subject to hooking and handling mortality.

e. Grazing

Grazing occurs throughout the Mad River basin on larger ranches in the upper portions of the Mad River landscape as well as more concentrated grazing along the reaches of the lower river and tributaries. A principal effect of this has been suppression of riparian vegetation and increased surface erosion near watercourses. Although efforts have been undertaken to exclude cattle from riparian areas, current data are not available describing to what extent this has occurred, nor to what extent grazing has impaired riparian vegetation and increased surface erosion in the action area.

f. Dams

Matthews Dam, located 84 miles upstream from the mouth of the Mad River, was constructed in 1961. Ruth Reservoir impounds runoff from approximately 121 square miles of the Mad River watershed (25% of the basin). Matthews Dam is a barrier to upstream migration, however, a series of falls and boulder fields prevents upstream migration past Deer Creek (RM 53) during most hydrological conditions.

Flows within the mainstem Mad River are influenced by releases from Matthews Dam. In general, flow releases from Matthews Dam have resulted in an increase in instream flows below the dam to the Essex Station 6 Facility during the summer and fall low-flow periods (Table 4), as well as reducing sediment transport from the upper watershed to the middle and lower portions. During winter storms, the reservoir fills rapidly and flows over the spillway.

The increased summer flows provided by the reservoir releases likely improve summer salmonid habitat along much of the mainstem. Currently, the upper limit for steelhead migration is between Wilson Creek (RM 45) and Deer Creek (RM 53) in a steep, boulder dominated reach with unstable side slopes. However, the changing character of the riverbed in this reach may allow anadromous fish to gain access to the upper watershed in the future.

Table 4. Monthly average releases from Matthews Dam (RM 84) and associated inflow into Ruth Reservoir for the low-flow period June through November.

Station	Month					
	June	July	August	September	October	November
Zenia (Ruth Inflow)(cfs)	51.1	8.0	1.3	1.1	6.3	168.2
Matthews Dam (Ruth outflow)(cfs)	92.4	64.5	79.5	85.8	87.3	149.8

Table 4 is intended to display the amount of flow augmentation to the mainstem Mad River due to Matthews Dam and operation of the District's diversion facilities at the Station 6 Facility. Flows at the Zenia gage, upstream of the reservoir, are assumed here to portray natural river flows absent the reservoir.

g. Water Withdrawals

The District withdraws water from the lower Mad River for both domestic and industrial uses. Water is released from Matthews Dam and a portion is pumped out of the river at the Essex Facility. The District withdraws between 30 and 80 cfs at the Station 6 Facility, resulting in a reduction in discharge below the Facility. The District calculated estimated natural daily flows (*i.e.*, unimpaired flows) below Station 6 Facility, and realized daily flows for the period of 1980-1998, and these data indicate realized flows were less than unimpaired flows approximately 45% of the time, and greater or equal to unimpaired flows 55% of the time. The reach between Station 6 Facility and the tidal zone (RM 4-9) is most likely to be affected by the sudden reduction in stream flow. This reach of river is important for rearing and outmigrating juvenile salmonids and adult fish passage during upstream migration. The period when reductions in flows may be most detrimental to salmonids is during low-flow summer months (July through September) when habitat and water quality are most likely to be limited. During the 1980-1998 period of record, impaired flows were no more likely to occur during summer low-flow months than other periods of the year. NMFS is not aware of any information that indicates the extent of the effects of reduced flows on instream habitat below Station 6 Facility. It is logical, however to assume that a reduction in stream flows below Station 6 Facility has contributed to reduced survival of some salmonids by slowing down the rate of juvenile outmigration and impairing upstream adult fish passage.

At the surface pumping facility, take of juvenile salmonids has occurred from operating the fish screens (District 2003). Past studies of fish capture at the Essex Station 6 Facility fish screens indicates that approximately 10-20 juvenile salmonids of each species are killed each year (Trinity Associates 1999). Retrofitting and modifications to the fish screens have been completed as part of this HCP (see *Proposed Action*), and NMFS anticipates these improvements will reduce the level of take in the future.

The District has conducted maintenance activities in the past that may have resulted in take of juvenile salmonids (NMFS 2003b). These maintenance activities have included: constructing a berm adjacent to the Station 6 Facility, constructing a trench upstream of the Station 6 Facility, dredging the forebay, and maintenance to existing rock structures in the Essex reach. The construction of the berm has resulted in the most perceptible impact to listed salmonids. As part of the berm construction activities, Halligan (2002) relocated 231 steelhead fry, and observed 48 steelhead fry killed during construction. However, in 2003, only one juvenile steelhead was observed and relocated, unharmed, during berm construction. Other activities have likely resulted in a short term reduction in water quality that may have reduced the fitness of listed salmonids.

h. Gravel Extraction

Downstream of the Mad River Hatchery, on the lower river reaches, gravel is extracted from the active channel of the mainstem Mad River. Historic gravel extraction on the Mad River is well documented in the Lower Mad River Programmatic Environmental Impact Review (Humboldt County 1994). Historic gravel extraction included winter drag-line operations, pits spanning the entire river, pits excavated in the flood plain, trenches along the low-flow channel, and bar skimming adjacent to the low-flow channel. Gravel extraction activities have been ongoing since the 1940s, when the primary method was the use of a drag line across the entire channel during the winter months which had significant impacts on channel form and function. CDFG eliminated use of the drag line method in the early 1970s. Estimates indicate that peak extraction occurred in 1970, when 771,000 cubic yards were extracted (Humboldt County 1994). The resulting impacts from gravel extraction to instream habitat were a reduction in the quality and quantity of pool habitat, a loss of instream cover, and an overall simplification of habitat for anadromous salmonids (Humboldt County 1994).

Understanding the potential reach-scale effects of the multiple extraction sites is important. In reaches where multiple excavations occur, bed lowering may occur downstream of the excavation sites, particularly if extraction rates exceed natural replenishment. This bed lowering can promote simplification of in-stream habitat elements as the extent of habitat-forming bars are decreased. Therefore, the removal of sediment, particularly if extraction rates exceed natural replenishment, can be expected to both lower bed elevations and increase lateral instability through bank erosion, each of which tends to simplify stream habitats.

Gravel extraction activities upstream of Station 6 Facility during the 1980s may have been a causative factor in the lowering of the river bed in the area of Station 6 Facility. The lowering of the bed in the 1980s has resulted in the need for the District to construct the berm and trench in recent years, to ensure adequate water delivery to the Station 6 Facility during low flow conditions.

Since 1992, the County of Humboldt Extraction Review Team (CHERT) has guided extraction methods and quantities along this reach. Extraction volumes and methods have been regulated with the objective of minimizing channel instability due to extraction. For the five-year period of 1997-2001, extraction volumes have averaged approximately 220,000 cubic yards per year (CHERT 2002 unpublished data). As a result of the overall decrease in gravel extracted from the Mad River in recent years, less impact to instream habitat has been observed.

i. Urbanization

The Mad River basin includes the communities of Blue Lake, Fieldbrook, and portions of Arcata. Much of the impacts of urbanization are in the form of rural development and associated road construction and land clearing. In Fieldbrook (Lindsay Creek watershed), numerous County roads crossing fish-bearing streams have created migration barriers. For example, Taylor (2000) identified six culvert fish barriers in the Lindsay Creek watershed as part of a county-wide survey effort. Five of these barriers have been or are currently being modified to provide fish passage (NMFS 2002). An estimated 3 to 5 miles of habitat will be opened up to CC Chinook salmon, SONCC coho salmon, and NC steelhead, as a result of these projects (pers. comm. with R. Taylor, biologist, Ross Taylor and Associates, April 2003).

B. Distribution and Status of Species in the Mad River

1. Overview

A number of fish monitoring projects have been conducted each year on the Mad River to help describe the abundance and distribution of salmonid species. These include monitoring that was conducted as part of the evaluation of Federally authorized gravel extraction activities. Since the Project and associated action area lies within the Mad River gravel extraction area, these monitoring data are useful to analyzing the effects of this Project. Halligan (1997a, 1997b, 1998, 1999, 2002, and 2003; hereafter 1997-2003) summarize the results of habitat mapping with direct observation, adult summer steelhead dives, temperature monitoring, and spawning/redd surveys in the Mad River gravel extraction area (RM 6.6 - RM 14), which includes the Station 6 facility at RM 9.

Halligan (2003) documents juvenile coho salmon, Chinook salmon, and steelhead presence in the survey reach (RM 6.6-14) during the summer of 2002, and also documents Chinook salmon spawning and adult steelhead and coho salmon migrating/holding throughout the survey reach. Spawning surveys conducted in the gravel extraction area between October 17, 2002, and

December 4, 2002, identified 132 Chinook salmon redds (Halligan 2003). In comparison, a survey conducted by Simpson Timber Company on a 9.3 mile stretch of the Mad River on November 21, 2002, between Simpson Creek and the Mad River Hatchery documented 238 redds (Glenn Whiteman, pers. comm., as cited in Halligan 2003).

Adult summer steelhead populations are monitored annually in August or September in the action area by direct observation. The results of this monitoring highlight the importance of this reach as adult summer steelhead holding habitat. According to Halligan (1997-2003), summer steelhead in the lower Mad River almost exclusively use pool habitats with woody debris cover and measurable flows.

Coho salmon, Chinook salmon and winter steelhead adults use the lower Mad River for holding prior to their upstream migrations and spawning. Adult coho salmon are typically seen in the lower Mad River, up to Wilson Creek (RM 45), in October through February, while adult Chinook salmon are usually observed beginning in September through January (Halligan 1997-2003). The ability to observe winter steelhead in the lower Mad River is confounded by visual limitations due to high flows and turbid water, but the marked increase in adult steelhead presence in October likely indicates the arrival of the more abundant fall- and winter-run steelhead.

Halligan (2003) documented juvenile coho salmon use of the lower Mad River. Previously, Halligan (1997) concluded that the relatively high summer water temperatures in the gravel extraction reach of the Mad River would not support coho salmon. However, Halligan (2003) documented coho salmon juveniles utilizing cold water refugia created by seeps in the lower river during the late summer of 2002, and also suggested that the coho salmon appeared healthy and robust. Halligan (2003) observed most coho salmon in the lower zone of the Mad River associated with pool habitat and either instream or overhanging vegetation providing cover.

2. Status and Abundance

There is a paucity of information regarding the status of steelhead, Chinook salmon, and coho salmon in the action area. No real population estimates are available for any of these species within the action area. Some watershed-level population estimates were described in the *Status of the Species* section.

a. *Steelhead*

The best available data for recent abundance estimates for adult summer-run steelhead in the action area are based on observations conducted as part of the gravel extraction monitoring (Table 5). No apparent trend is seen from these data.

Table 5. Adult summer steelhead observed during dive observations on the Mad River from Highway 101 Bridge to the Blue Lake Hatchery (RM 4 -17), 1996-2002 (Halligan 2003).

Survey year	Total Number observed*
1996	59
1997	11
1998	13
1999	2
2000	30
2001	23
2002	8

* These totals do not include half-pounders or hatchery-origin fish.

Historical estimates of NC steelhead at Sweasey Dam on the Mad River ranged from 3,800 (Murphy and Shapovalov 1951) to 2,000 (McEwan and Jackson 1996), not including estimates by CDFG in 1965. In 1965, CDFG estimated NC steelhead ESU escapement at 198,000, with the Mad River spawning population at 6,000 fish (Busby *et al.* 1996), representing approximately 3% of the total population in the ESU. The Mad River also supports a small population of summer-run steelhead which hold in deeper pools of the mainstem Mad River over the summer months (Simpson 2002). CDFG's trapping study of outmigrants in 2001 estimates the abundance of one-year-old steelhead was 11,455 [95% confidence interval (CI): 6,297-16,613 individuals], and two-year-old steelhead was 63,918 (95% CI: 29,038-98,798 individuals, CDFG 2002).

b. Chinook salmon

Chinook salmon spawner surveys have been intermittently conducted, and are not comparable due to differences in timing and locations of the surveys. However, it should be noted that Chinook salmon spawning has been observed in most years. A conservative estimate of 264 Chinook salmon adults spawned in the lower Mad River in 2002, based on redd counts and an estimate of two salmon per redd (Halligan 2003). The number of Chinook salmon spawning in the lower Mad River may be influenced by water year type and access to tributaries during low flows. During years of dry fall and early winter, Chinook redds are more abundant in the lower Mad River.

In 1965, CDFG estimated Chinook salmon escapement in the California portion of the SONCC Chinook salmon ESU at about 88,000 fish, including approximately 5,000 fish in the Mad River, or approximately six percent of the California salmon population (CDFG 1965). More recently, CDFG estimated the abundance of young-of-the-year Chinook salmon in the lower Mad River from March 30 through July 14, 2001, using a downstream migrant trap. CDFG (2002)

concluded that the Mad River population estimate of young-of-the-year Chinook salmon in 2001, was 954,027 (95% CI: 854,178-1,053,876 individuals).

c. Coho salmon

The status of coho salmon in the action area is unknown, except that Halligan (2003) documented that “hundreds” of juveniles were observed in a reach that included the Essex Station 6 Facility and extended upstream approximately three miles during the summer of 2002.

Coho salmon migrating above Sweasey Dam at RM 22 were counted by CDFG from 1938-1964. On average, 474 coho salmon passed the dam with a high of 3,580 fish in 1962 and a low of 3 fish observed in 1958 (CDFG 1968). In 1959, CDFG began artificially rearing coho salmon and stocking them in the watershed, and is thus likely responsible for the increased returns seen from 1961 to 1963. The California Department of Water Resources (CDWR) reported most coho salmon utilized the tributaries of the lower Mad River watershed (CDWR 1965). Since the early 1970s, the number of coho salmon adults returning to the Mad River Hatchery has declined. It should be noted, however, that in the early 1990s the weir that directed fish into the hatchery ceased to operate, allowing adults to pass the facility. From 1985 to 2000, adult coho salmon counted in index reaches in Cañon Creek averaged five, and in the North Fork Mad River averaged 10, with the highest counts occurring in the first five years of this period for both streams (CDFG 2000b).

3. Distribution

Adult SONCC coho salmon migrate into and through the lower Mad River from mid-October through February, and spawning occurs between November and February. Juveniles rear in the lower zone between April and June. Smolts emigrate from the lower Mad River to the Pacific Ocean from March to early June, with a peak in late May.

Adult CC Chinook salmon migrate into the lower Mad River primarily from October through December, although a few adults enter the river in September. Spawning occurs from November through February with a peak in December and January. Juvenile Chinook salmon rear in the lower Mad River from March through June, while smolts emigrate to the Pacific Ocean from March through June with a peak in May through June (CDFG 2002).

Adult NC steelhead migration occurs from September through April, and May through June as winter- and summer-run steelhead enter the river to spawn. Spawning occurs from December through April. Juvenile steelhead rear in the lower zone of the Mad River and tributaries all year long. Smolts emigrate to the Pacific Ocean from March through June with a peak in mid-April and May.

C. Synthesis of Baseline Information

In summary, the environmental conditions which have affected the distribution and abundance of Mad River anadromous salmonids are as follows:

- Historically, the mouth closed during low flow conditions, potentially increasing the risk of predation from seals and sealions. Presently, the mouth remains open, although adults migrating upriver still wait for the first fall freshets to enter the river.
- Historically, the lower 61 miles of the river were naturally perennial; the reaches above RM 61 were naturally intermittent.
- As a result of urbanization and growth, the estuary and tidal reach of the river have been disconnected from adjoining tidelands, tidal sloughs, and wetland habitat that was once important rearing habitat and refugia for juvenile salmonids.
- Rearing habitat is limited, particularly for juvenile Chinook salmon. The mainstem also exhibits limited structural diversity which is normally provided by large woody debris, and as a result, rearing habitat is limited.
- The middle zone (RM 34-61) is a major source of sediment that affects the quality of aquatic habitat down river. Natural barriers exist which prevent anadromous salmonid migration to the upper river zone. Only the lower 45 to 53 miles of the mainstem are accessible to adult coho salmon and Chinook salmon.
- Steelhead occasionally spawn in the upper zone if flow conditions and the boulder reach configuration are conducive to adult migration.

Suspended sediment is a significant water quality issue in the Mad River, resulting in the EPA listing the watercourse as sediment (turbidity) impaired under section 303(d) of the CWA. The Mad River basin is one of several in northern coastal California, where suspended sediment levels are 5 to 50 times that of comparably sized streams in the United States. These sediment levels are partly attributed to natural geologic characteristics of the basin and also to past and ongoing anthropogenic activities.

The Mad River reflects a long legacy of watershed disturbances. Streamside vegetation removal, in-stream gravel extraction dating back many decades combined with intensive upslope activities such as timber harvest, road construction and grazing, and large floods have had a significant influence on the condition of the lower Mad River. Distribution of salmonids in the Mad River watershed indicate that the Essex portion of the action area is vital to salmonids - particularly spawning Chinook salmon. In low flow years, the proportion of the Chinook salmon population utilizing the lower river may be high assuming that tributaries are largely inaccessible and spawning is confined to the mainstem. The lower river may also provide a valuable, albeit

limited, rearing area for salmonids from tributary and upstream reaches due to density dependent emigration. In this role, the lower river would provide a critical function for survival and recovery of the species.

VII. EFFECTS OF THE ACTION

NMFS provided an overview of the proposed action in the *Description of the Proposed Action* section of this Opinion. In the *Status of the Species* section of this Opinion, NMFS provided an overview, at the ESU scale, of the status and trends of SONCC coho salmon and their designated critical habitat, CC Chinook salmon, and NC steelhead. In the *Environmental Baseline* section of this Opinion, NMFS summarized the effects of past and present Federal, State, local and private activities on SONCC coho salmon and their designated critical habitat, CC Chinook salmon, and NC steelhead within the action area. The *Environmental Baseline* section established that numerous human activities occurring upstream of and within the action area have adversely affected SONCC coho salmon and their designated critical habitat, CC Chinook salmon, and NC steelhead, and the distribution and abundance of these species in the action area.

In this section of the Opinion, as required by the ESA and its implementing regulations (50 CFR § 402), NMFS assesses the direct and indirect effects of the proposed action on SONCC coho salmon and their designated critical habitat, CC Chinook salmon, and NC steelhead together with the effects of other activities that are interrelated or interdependent with that action. The purposes of this assessment are to determine if the proposed action: (1) is likely to have effects on SONCC coho salmon, CC Chinook salmon, or NC steelhead that appreciably reduce their likelihood of both survival and recovery in the wild by reducing their numbers, reproduction, or distribution (the jeopardy standard identified in 50 CFR § 402.02); or (2) is likely to destroy or adversely modify designated critical habitat for the conservation of SONCC coho salmon in the wild.

Critical habitat is defined as the specific areas within the geographical areas occupied by the species, at the time it is listed, on which are found those physical and biological features essential to the conservation of the species and which may require special management considerations or protection, or specific areas outside the geographical area occupied by the species at the time it is listed when the Secretary determines that such areas are essential for the conservation of listed species. The ESA further defines conservation as "to use all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to the ESA are no longer necessary." As a result, 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.

A. Assessment Approach

To conduct our assessment of the proposed actions, NMFS considers the direct and indirect effects of the proposed action and any interrelated and interdependent actions on the area, connectivity, and quality of habitats that support listed species as well as effects that result in injury or death to listed species. NMFS uses published and unpublished data and studies of interactions between gravel mining operations and listed species or their habitats to estimate the likelihood of future effects. There is an extensive amount of published literature on the relationship between changes in habitat quantity, quality, and connectivity and the persistence of animal populations. For detailed summaries of this literature, readers can refer to the work of Fiedler and Jain (1992), Gentry (1986), Gilpin and Soule (1986), Nicholson (1954), Odum (1971, 1989), and Soule (1986, 1987). With respect to listed species, NMFS bases its assessment on the relationship between habitat and species populations and assumes that an activity that destroys or modifies habitat listed species are dependent upon will be followed by a demographic response (e.g., changes in birth rates, death rates, or other vital rates, abundance, etc.) and assume this response will result in a substantial reduction in the diversity of the ESU.

A fundamental assumption used in this effects analysis is that salmonids are limited by habitat in the action area and that adverse effects on habitat equate to adverse effects on salmonid populations. Gregory and Bisson (1997) stated that habitat degradation has been associated with greater than 90% of documented extinctions or declines of Pacific salmon stocks. This assumption is also supported by Lichatowich (1989) who identified habitat loss as a significant contributor to stock declines of coho salmon in Oregon's coastal streams. Beechie *et al.* (1994) estimated a 24% and 34% loss of coho salmon smolt production capacity of summer and winter rearing habitats, respectively, in a Washington stream since European settlement. Beechie *et al.* (1994) identified three principal causes for these habitat losses, in order of importance, as hydromodification, blocking culverts, and forest practices. Several authors have found positive relationships between habitat complexity, LWD in streams, and salmonid populations (McMahon and Holtby 1992, Reeves *et al.* 1993, Tschaplinsky and Hartman 1983). Nickelson and Lawson (1997), in modeling extinction risk of coho salmon along the Oregon coast, found that probability of extinction was inversely related to habitat quality for starting populations of 50 and 100 individuals. Furthermore, Nickelson and Lawson (1997) found that there would be a substantial increase in risk of extinction for Oregon coast coho salmon in basins with poor habitat quality if habitat quality declines by 30-60% over the next century.

Diversity of salmonid populations includes both genotypic and phenotypic diversity. Regardless of whether the diversity is genetically controlled or not, diversity allows greater exploitation of a variety of habitats and, therefore, leads to greater abundance and increases resilience by spreading risk and providing redundancy in the face of unpredictable catastrophes and environmental stochasticity (NRC 1995). For example, steelhead in the action area include both summer- and winter-run life history types. This variability in run timing reduces the risk that complete loss of a years adult return would occur in the event of a catastrophe and also allows exploitation of habitats that might otherwise be unavailable.

Additionally, our assessment must consider the effects of maintaining or inhibiting recovery of habitat conditions that led to the initial listing of salmonids under the ESA. If we determine that habitat conditions will be maintained in a degraded condition and, therefore, will limit potential for recovery or substantially decrease the rate of recovery of listed salmonid populations, then we must consider the increased risk that genetic, demographic, and environmental stochasticity will further negatively affect populations. In essence, if the action maintains habitat in a degraded condition or inhibits its recovery, then it also decreases the probability that species will survive over the long-term (NRC 1995).

To assess the effects of the proposed action, NMFS considered the short-term, direct effects of the proposed actions on salmonids. These include effects that occur at the time of instream construction activities, operation of the fish screen, and flow management. We then describe the general long-term effects associated with the proposed action. These effects primarily occur as changes in channel form and function and are described in terms of expected changes to stream habitat types used by salmonids for various life history stages. Prior to synthesizing the effects of the action, we consider the cumulative effects that are reasonably likely to occur in the action area.

Finally, we integrate and synthesize the effects of the action combined with the cumulative effects. In this step, we consider the aggregate of effects on the populations of the three salmonid species and SONCC coho salmon designated critical habitat. The expected response of salmonid populations is determined by assessing any potential reductions in the numbers, reproduction, or distribution of listed salmonid populations in the action area. We then determine whether any reductions in numbers, reproduction or distribution will appreciably reduce likelihood of survival and recovery of listed salmonids. These final steps take into account the status and trends of the population or ESU in question, the factors currently and cumulatively affecting them, and the role the affected population likely plays in the ESU.

B. Effects Related to the Proposed Action

1. Current activities which occur on an ongoing basis

a. Releasing Flow at Matthews Dam and Diverting Water in the Essex Reach of the Mad River.

Dams throughout the Pacific Northwest have had profound effects on the populations of anadromous salmonids inhabiting these watersheds. The act of water impoundment serves not only to store water but also store coarse sediment that would otherwise be available downstream for spawning. Dams have blocked habitat that historically was available to salmon and steelhead. The natural hydrographs that shape the morphology have been altered, reducing the quality and quantity of instream habitat. In turn, the system of dams throughout the range of the Pacific Northwest are, in part, responsible for the decline of salmonid populations.

The impact of dams on fish populations and their habitat varies widely, based on a number of factors. For example, the District (2003) states flow releases from Ruth Lake “provide a significant increase in flow during the Mad River’s critical low-flow months, compared to naturally occurring flows.” Releasing flow at Matthews Dam may affect listed salmonids in a variety of ways, some beneficial, some adverse.

NMFS anticipates the release of flow at Matthews Dam and water diversions in the Essex Reach will result in the following:

- (1) Alterations in the natural hydrograph between Matthews Dam and the estuary.
- (2) Stranding of fish due to variations in flow releases.

(1) Alterations in the natural hydrograph between Matthews Dam and the estuary. NMFS anticipates flow releases during the period of the HCP will be consistent with the flow regime released during the period of 1989 through 2001. During this period, District Operations have, in general, increased natural flows in the Mad River from Matthews Dam to the Station 6 Facility in every month except December (Table 6).

Table 6. District’s flow releases from Matthews Dam compared to natural flow, monthly average 1989-2001.

	Jan	Feb	Mar	Apr	Ma y	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Natural flow above Ruth Reservoir, prior to District Operations (cfs)	772	622	500	250	123	59	9	1	0	5	55	320
District releases from Matthews Dam (cfs)	941	812	691	342	177	111	58	70	77	77	70	281
Net change in flows resulting from flow releases (cfs)	169	190	191	92	54	52	49	69	77	72	15	-39

Daily mean flows recorded approximately nine miles downstream of Matthews Dam at USGS gage station near Forest Glen indicate an increase in discharge relative to the unimpaired hydrograph, from District Operations during the low-flow months of August through October (Table 7).

Table 7. Average daily mean stream flows (cfs) during low-flow months (1953-1994) at USGS Station near Forest Glen.

Period 1- Prior to Operation of Matthews Dam, 1953-1961.								
August			September			October		
Minimum flow (cfs)	Maximum flow (cfs)	Mean flow (cfs)	Minimum flow (cfs)	Maximum flow (cfs)	Mean flow (cfs)	Minimum flow (cfs)	Maximum flow (cfs)	Mean flow (cfs)
2	8	4	2	10	5	2	279	27
Period 2- Since Operation of Matthews Dam, 1962-1994.								
August			September			October		
Minimum flow (cfs)	Maximum flow (cfs)	Mean flow (cfs)	Minimum flow (cfs)	Maximum flow (cfs)	Mean flow (cfs)	Minimum flow (cfs)	Maximum flow (cfs)	Mean flow (cfs)
73	97	85	81	107	93	72	250	112

Historically, the Mad River's upper reaches frequently went dry. Under District operations, flow releases appear to provide a greater and more consistent flow in the upper reaches of the Mad River during dry summer months. The District estimates an increase in instream habitat of approximately 450 acres resulting from District Operations (District 2003).

Historical flow data indicate that operation of Matthews Dam has not reduced average flows below that which occurred naturally during September, October and November (the period during which the first storms of the season occur), nor has the operation of Matthews Dam markedly changed the natural hydrograph. Matthews Dam is sited such that approximately 25% of the Mad River basin lies above the dam and reservoir. The average annual discharge of the Mad River basin to the Pacific Ocean is slightly greater than 1,000,000 acre-feet. Ruth Reservoir has a retention capacity of 48,000 acre-feet, which in an average year is drawn down to approximately 30,000 acre-feet. Under current operational conditions during an average water year, the natural runoff below the dam is diminished by 20,000 acre-feet, which represents only 2% of the river's total natural runoff (District 2003). Due to the location of Matthews Dam, the hydrograph of the Mad River within the range of anadromous fish is responsive to most fall and winter rainfall

events, and the resultant changes to the natural hydrograph during storm events on instream habitat of juvenile and adult salmonids are negligible.

Flow releases proposed by the District will likely have some beneficial effects for juvenile salmonids in the 75-mile reach between the Station 6 Facility and Matthews Dam (Table 7). Juvenile salmonids rearing in the mainstem river will experience, in general, an increase in available habitat when compared to the natural hydrologic regime. An additional beneficial effect of Matthews Dam may be realized by cold water releases that occur from the bottom of Ruth Reservoir. Ruth Reservoir will periodically develop a thermocline during summer months, and during these times, releases from Matthews Dam will likely be cooler than natural stream temperatures.

Adult salmonids returning to spawn may be influenced by flow releases. For example, at the beginning of the fall rainfall period (mid- to late-October) the reservoir level may be twenty to twenty-five feet below the spillway. As a consequence, the majority of inflow above the dam resulting from early rain storms is impounded. During this period, however, the District proposes to release between 50 cfs to greater than 100 cfs during these early storm periods. The resulting short-term impact to daily runoff resulting from impoundment from early September storms is likely to be minimal. Based on transit times developed by the District, storm events occurring in the upper basin under natural conditions would not result in a marked increase in flows for 60 to 70 hours, at which time the contributing flows of the remaining drainage would reduce the effects of reduced flows at Matthews Dam. Accordingly, while adult salmonids entering the lower river may experience a reduction in pulse flows during early storm events, upstream fish passage will likely be improved due to a generally higher base flow resulting from District Operations.

As part of the District's water rights permit (Permit Nos. 11714, 11715, March 16, 1959), CDFG required minimum bypass discharges for flows below Station 6 Facility to protect aquatic habitat. Since 1980, the District, in general, has operated in a manner that has provided flows greater than the CDFG minimum requirements (Table 8). During the period of 1980-1998, the District was most likely to not meet the minimum bypass flows below Station 6 Facility during dry and normal water year types, during August and September (Table 8). However, under the HCP, the District has proposed to rectify any failures to meet minimum bypass flows by immediately increasing flows from Matthews Dam. Should USGS provide a revised correction factor for the gage downstream of Station 6 Facility that indicated actual flows were less than anticipated, the District would also release additional flow to rectify any shortfalls in flow requirements.

Table 8. CDFG required minimum bypass discharge (cfs) below Station 6 Facility, and actual average monthly discharge for three water year types during the period, 1980-1998 (District 2001).

Month	Bypass Discharge (cfs)	Actual Mean Monthly Discharge(cfs)		
		Dry Water Year	Normal Water Year	Wet Water Year
Oct	30-50	96	84	155
Nov	75	1300	846	1899
Dec	75	1272	3418	3831
Jan	75	1806	4427	4371
Feb	75	1688	3836	4089
Mar	75	2684	3320	3728
Apr	75	1175	1688	2661
May	75	477	824	1215
Jun	75	250	479	446
Jul	50	62	84	103
Aug	40	32	32	58
Sep	30	24	99	42

The District compared actual flows below Station 6 Facility to estimated unimpaired flows below Station 6 Facility (*i.e.*, without Matthews Dam and water diversions). Flow data indicate that under the District's operation between 1980 and 1998, impaired flows were no more likely to occur during low-flow summer months than unimpaired flows (District 2002). The District has proposed to operate the Station 6 Facility and flow management in a manner that results in flows downstream consistent with the 1980 through 1998 period. As described above, the flows below Station 6 Facility may be less than, equal to, or greater than estimated unimpaired flows. However, during periods of water diversion at Station 6, juvenile salmonids migrating downstream beyond the Station 6 Facility will experience an instantaneous reduction in flow as a result of the diversion. The amount and extent of this reduction will be dependent upon the amount of diversion at Station 6 Facility, and will not exceed 80 cfs. Reduced flow may adversely affect smolts in a number of ways. Smolts migrating downstream during the March through June period may be forced to utilize less than optimal habitat if a reduction in flow results in a reduction of instream habitat and habitat is limited. The resulting effect to individuals may be

a greater energetic cost as fish are forced to use habitat that is higher velocity than preferred, or an increase in their risk to predation due to being forced to utilize habitat deficient of cover. Similarly, young-of-the-year salmonids rearing in the Mad River below Station 6 facility may experience a reduction in available habitat as they move from above to below the Station 6 Facility. A reduction in flow may also result in an increase in the transit time of smolts, further increasing their susceptibility to in-river risks (*i.e.*, disease, predation). NMFS anticipates these potential effects will extend from Station 6 Facility at RM 9 downstream to the tidal zone of the Mad River at RM 4 where tidal influence is expected to ameliorate the effects of reduced flow.

Adult salmon and steelhead entering the Mad River in summer and fall may also experience impaired flows. As a result, fish passage of those adult salmonids may be impaired making them more susceptible to fishing pressure, density-dependent diseases, and risks from other predators (*e.g.*, seals). Fall Chinook salmon entering the Mad River in September during low flow conditions are often observed in high densities in pools downstream of the Station 6 Facility.

In analyzing these potential adverse effects to listed salmonids, NMFS was not provided with any monitoring or anecdotal observations to suggest the extent that these potential adverse effects have occurred under past operations. Of those investigations that have occurred downstream of Essex Station 6 Facility (*e.g.*, Trinity Associates 1995, Halligan 2003), the potential loss of habitat due to water diversions has not been quantified. The paucity of data regarding these potential effects warrants further investigation. At this time, due to the relatively short distance of river (*i.e.*, 5 river miles) potentially affected by flows greater than unimpaired conditions, and the potential benefits to listed salmonids associated with augmented flows through most of the Mad River basin, NMFS anticipates the potential adverse effects of reduced flows below Station 6 Facility to listed salmonids will be offset by the potential benefits of increased habitat upstream of Station 6 Facility.

(2) *Stranding of fish due to variations in flow releases.* Reductions in river flow and stage height may result in stranding of juvenile salmonids as habitat decreases and fish become isolated from the active channel. Stranding occurs during natural hydrologic conditions, however, anthropogenic influences that exacerbate instream flow reductions increase the risk of stranding. To minimize risks of stranding, the District proposes the following: “During low-flow times of the year (100 cfs or less), if the District plans to reduce its releases at one time by more than 25 percent, it shall do so in gradual increments over a 24-hour period to ensure no stranding will result (District 2003).”

NMFS anticipates District Operations at Matthews Dam will have a negligible effect on stranding of listed salmonids downstream. Matthews Dam is approximately 30 river miles from the upstream end of anadromous fish habitat. Accretions from tributaries downstream of Matthews Dam will likely ameliorate the effect of reductions in flow during ramp-downs. Further, most ramp-down activities occur during the fall period when rain storms begin to provide opportunities for the District to store water. Salmonid fry that inhabit edgewater portions of the channel most affected by reductions in flow are not abundant in the fall. By September, young-of-the-year

salmonids have grown to a size where in general, they inhabit deeper water and no longer utilize the margin of the river that is most adversely affected by reductions in flow caused by ramp-downs.

b. Operating Fish Screens at Station 6 Facility.

Retrofitting was completed in 2004. With retrofitting, the screens are anticipated to be “fish tight,” reducing the likelihood of entrainment of juvenile salmonids. Prior to any retrofitting activities, Trinity Associates (1999) conducted a study at the Station 6 Facility, documenting monthly entrainment rates for Chinook salmon, coho salmon and steelhead, by dividing the number of fish entrained by the amount of time the screens operated (number of fish/hour, Table 9). For the purpose of the study, from March through September, the screens were run every 24 hours instead of every 96 hours. Because juvenile salmonids out-migrate seasonally, entrainment rates were calculated for each month. March and April were the peak months of entrainment for Chinook salmon and steelhead; and coho salmon entrainment peaked in May, June and July. The highest entrainment rate for Chinook salmon was 1.23 fish/hour in March, for coho salmon it was 0.15 fish/hour in May, and for steelhead the highest entrainment rate was 0.85 fish/hour in April. NMFS assumes those fish entrained by the screen ultimately die.

Trinity Associates (1999) concluded that 50% of the 28 entrained steelhead were marked-fish released from CDFG’s Mad River Hatchery. The entrainment rate of marked yearling steelhead was low (less than 0.006%), assuming all marked fish passed the Station 6 Facility.

While Trinity Associates (1999) provides good information on the expected level of take associated with operating the Station 6 Facility fish screens, other factors must also be considered. For example, the abundance of fish in 1998 may not be representative of future runs. Also, no level of statistical confidence was provided with Trinity Associates (1999) results. However, these results do indicate a relatively small number of juvenile salmonids interacting with the fish screens will be captured and die as a result.

The District has proposed a three-phase monitoring program intended to ensure that the level of take associated with operating the fish screens does not exceed one percent of the juvenile Chinook salmon exposed to the fish screens. Only a small portion of the population of fish are likely to be exposed to the fish screens. Given the successful implementation of the District’s Monitoring Program associated with their fish screens, and the effectiveness of retrofitting actions, NMFS anticipates the number of fish entrained and killed at the fish screens will be very low and not significant to the populations in the Mad River.

Table 9. Capture Rate Measured (Number of Fish Per Hour of Screen Run Time), Multiplied By Normal Monthly Screen Run Time of Five Hours, Based on 1998 Hilfiker Pump Station Fish Study (Trinity Associates 1999).

Month	Coho Salmon	Chinook Salmon	Steelhead
January	0	0	0.06 yields 0.3 fish
February	0	0.65 yields 3.25 fish	0.06 yields 0.3 fish
March	0	1.23 yields 6.15 fish	0.18 yields 0.9 fish
April	0.05 yields 0.25 fish	0.65 yields 3.25 fish	0.85 yields 4.25 fish
May	0.15 yields 0.75 fish	0.10 yields 0.5 fish	0.05 yields 0.25 fish
June	0.10 yields 0.5 fish	0.05 yields 0.25 fish	0
July	0.11 yields 0.55 fish	0.05 yields 0.25 fish	0.11 yields 0.55 fish
August	0	0	0.16 yields 0.8 fish
September	0	0	0.06 yields 0.3 fish
October	0	0	0.06 yields 0.3 fish
November	0	0	0.06 yields 0.3 fish
December	0	0	0.06 yields 0.3 fish
Total	2.05 fish	13.65 fish	9.05 fish

c. Dredging of Forebay at Station 6 Facility.

To ensure adequate water flow to the Station 6 Facility, the District excavates sediment from the forebay accumulated during winter high-flow events. The District uses either a crane or clamshell bucket to scoop silt and gravel from the forebay. A similar technique is used to excavate sediment from an area of the Mad River bed directly in front of the forebay to ensure a continuous flow of water into Station 6 Facility. The frequency of dredging is dependent upon the number and intensity of storm events. If the stage height of the Mad River at Essex exceeds 26 feet, sediment settles in and around the forebay as high flows recede. Based on the events of previous years, the District anticipates having to excavate on average twice a month during the winter season (November to March). However, it is possible they may have to dredge as many as five times a month during extended periods of heavy rain.

Salmonids are not excluded from utilizing either the forebay or areas excavated directly in front of the forebay. Juvenile salmonids are likely to rear in the mainstem Mad River during the winter season, but not in large abundances. One year and older juvenile steelhead utilize the mainstem Mad River during winter months, and juvenile salmonids displaced from tributaries during high-flow events are likely to be present as well. The forebay is described in the HCP as habitat similar to a backwater holding pool. Backwater holding pools are important winter

refuge for both adult and juvenile salmonids from high winter flows (Heifetz *et al.* 1986, Hassler 1987). Therefore, it is likely that the forebay attracts salmonids during the periods time when the District may conduct these excavation actions. The forebay provides potential refuge from high water velocities. Accordingly, juvenile salmonids are likely to be present during dredging actions.

Adult salmonids are less likely to be present in the forebay during dredging activities. During high flow events, adult salmonids are, in general, migrating to upstream spawning locations and unlikely to hold in the off-channel habitat of the forebay. However, adult salmonids may hold in the location directly in front of the forebay. During winter months, when conditions allow, fishermen are often observed in the vicinity of the forebay, indicating that adult salmonids may hold in this area.

The District describes its method of minimizing take from this action as the following:

“Personnel will strike the top of the water with the bucket prior to starting the dredging in an attempt to scare away any fish which may be present.”

The use of a crane or clamshell bucket to excavate material from the active channel may adversely affect listed salmonids by: injuring or killing individuals as the bucket is maneuvered through the water column; capturing individuals in the bucket and removing them from the river; and disturbing sediment, thereby increasing the level of turbidity in the water column.

Salmonids may be injured or killed by the operation of the clamshell or crane bucket. The greatest risk will be to those individuals in their early life history phases (*e.g.*, fry and one-year old) because of their relative abundance and the constraints to their ability to flee from danger. Juvenile salmonids will also burrow into substrate as a method of flight, further increasing their susceptibility to harm associated with this action. Since the District anticipates this action will most likely occur during turbid conditions, it is possible even adult fish, disoriented by poor visibility, may be susceptible to injury or capture. However this risk is highly unlikely due to their strong swimming capabilities and abilities to flee from slow moving objects such as the clamshell or crane bucket. The degree to which individuals may be injured or killed from this action is not known. In the past, District staff conducting these actions have not observed any dead fish, however, it is unlikely fish would be observed because of the turbid conditions of the water. The greatest risk to listed salmonids will be to those individuals in their early life history form (*e.g.*, fry and one-year old).

A short-term increase in suspended sediment will occur as a result of this action. The extent of this effect is not known. NMFS is unaware of any monitoring associated with the effects of this action on turbidity. However, the District proposes to draw most of the turbid water into the Station 6 Facility by increasing the diversion rate at the Station 6 pumps.

d. Maintain adequate water surface elevation to Station 6 during low-flow months

The District anticipates constructing a berm between late May through June as a means of maintaining adequate water surface elevation to Station 6 Facility. NMFS anticipates this action will be phased out within 5 years following the completion and implementation of the District's feasibility study to develop a long-term solution to maintaining adequate water surface elevation.

The downstream migration of juveniles salmonids from the Mad River peaks between March and June. While there is an inherent variability in all salmonid migration timing, project activities will likely overlap with the presence of juvenile coho salmon, Chinook salmon, and steelhead in the action area. NMFS anticipates adult summer steelhead will also be present in the action area during construction.

Construction of the berm could result in the following:

- (1) Capture and relocation of fish.
- (2) The stranding and crushing of juvenile salmonids as a result of the construction of the berm.
- (3) Long- and short-term alteration of physical habitat.
- (4) Sediment delivery and increased turbidity to the Mad River.
- (5) Fuel and hazardous contaminant spills.

(1) Capture and relocation of fish. The District proposes to employ a fisheries biologist to disperse fish prior to and during the construction of the berm. The variable nature of fish abundance and distribution, and morphological variability to the physical environment in the berm construction area make it difficult to forecast what techniques may be employed to best disperse, capture, or relocate fish. Fish may be captured using a variety of gear, including: hand nets, seines, or electrofishing equipment. Adverse effects are expected to occur in three forms: (1) non-lethal harassment for the amount of time it takes for the fish to be dispersed, (2) mortality during capture and transport, and (3) non-lethal harassment during capture and transport.

Capturing and relocating fish by seining, netting, and electrofishing could stress or possibly kill salmonids due to fright, injury, or from adjusting to new habitat areas. Listed salmonids may become more susceptible to predation, and disease, as a result of handling and relocation stress.

Electrofishing can result in severe effects to fish, including death, spinal injuries, burns, hemorrhaging, and physiological stress. Electrofishing can kill both juvenile and adult fish (Reynolds and Kolz 1988, Sharber and Carothers 1988, Nielsen 1998). The amount of mortality attributable to capture and handling may vary widely depending on the equipment used, the settings on the equipment, ambient conditions, and the expertise and experience of the technicians. Based on relocation efforts of past years, the District does not anticipate using electrofishing as a method of fish relocation. The exact numbers and distribution of listed salmonids in the construction area will not be known; however, NC steelhead is the listed species most likely to be present in the edgewater and side channel habitat during the construction of the

berm (Halligan 2002). Halligan (2002) reported a much greater abundance of steelhead fry in 2002 than either 2000 or 2001. In 2002, Halligan relocated 231 steelhead fry during berm construction activities, and observed 48 steelhead fry killed during berm construction activities. However, in 2003, only one juvenile steelhead was observed and relocated, unharmed, during berm construction.

Quantifying the number of salmonids that may be captured, relocated, harrassed and/or killed is difficult. The amount will be affected by: (1) the number of listed salmonids present in the construction area, (2) the construction methods employed, (3) the timing of construction, (4) the duration of construction activities, and (5) the methods used to disperse or relocate listed salmonids.

NMFS (2003b) provided the following guidelines to the District as a means to reduce the amount of take associated with relocation efforts. The District proposes to use these protocols as guidelines for future relocation actions, to be discussed in annual pre-construction meetings with NMFS and other agencies. These guidelines may be modified if it is not anticipated further harm will occur resulting from changes to these guidelines:

1. A first attempt to capture fish stranded in the construction area shall be made using seine nets and dip nets, where possible, and, if necessary, electrofishing. The first attempt should occur no earlier than three hours prior to the commencement of construction.
2. As construction begins, fish shall continuously be removed using seine nets and dip nets when possible before electrofishing.
3. Release fish a sufficient distance downstream of the construction site to ensure low impact from degraded water quality and future risks from construction. Minimize handling of salmonids. When handling is necessary, always wet hands or nets prior to touching fish.
4. Place captured fish in a cool, shaded, aerated, dark colored container filled with cool, clear water. Provide aeration with a battery powered external bubbler. Protect fish from jostling and noise and do not remove fish from this container until time of release. Release fish as described above as soon as possible.
5. Place a thermometer in the holding container, and periodically (*i.e.*, every 15 minutes) check water temperatures. Release fish if water temperature exceeds 68 degrees Fahrenheit, or within 30 minutes of capture.
6. Avoid overcrowding in containers. Have at least two containers and segregate young-of-the-year fish from larger age classes to avoid predation. Densities should not exceed 5 fish per gallon of water in each container. If found, place large amphibians, such as Pacific Giant salamanders, in the container with the larger fish.

7. Visually identify species and estimate year classes of listed salmonids at time of release. Do not anesthetize or measure listed salmonids.
8. If mortality during relocation exceeds 5% of fish captured, stop efforts and immediately contact NMFS. In the event that any listed species is injured or killed, care will be taken in handling of injured specimens to ensure effective treatment and care, or the handling of dead specimens to preserve biological material in the best possible state for later analysis of cause of death and ensure that evidence intrinsic to the specimen is not unnecessarily disturbed. All listed species mortalities must be retained, placed in an appropriately sized whirl-pak or zipper-locked bag, labeled with the date and time of collection, fork length, location of capture, and frozen as soon as possible. Frozen samples must be retained until specific instructions are provided by NMFS.

In the future, an abundance of salmonids may be present in the berm construction area, and in portions of habitat that may be dewatered by the construction of the berm. While the 2002 construction activities resulted in the death of at least 43 individuals, NMFS thinks future pre-project monitoring and planning efforts, along with the implementation of the above described protocol, will prevent future mortality events similar to what was observed in 2002.

(2) *The stranding and crushing of juvenile salmonids as a result of the construction of the berm.* Salmonids select gravel substrate in shallow water with intra-gravel flow, typically the crests of riffles, to bury their fertilized eggs. The number of days required for eggs to hatch varies from about 19 days to about 90 days depending on species and water temperature. Alevin then emerge from the gravel two to three weeks after hatching (Barnhart 1986). Once alevins emerge, they disperse to occupy available low-velocity portions of the stream and areas with cover (Raleigh *et al.* 1984). During this early life stage, juveniles usually occupy shallow water along the stream banks (Barnhart 1986). Steelhead also use riffles and other areas not strongly associated with cover which provide increased foraging opportunities (Bradford and Higgins 2001), and large pore spaces in the stream bed. In one experiment using artificial stream channels, over 50% of juvenile steelhead 31-44 mm in length were located in riffle habitat (Bugert and Bjornn 1991). Juvenile steelhead remain in these rearing areas throughout the summer, with some shift in habitat use as they age and as conditions change (Chapman and Bjornn 1969).

Cover is an important habitat component for juvenile salmonids, both as a velocity refuge and as a means of avoiding predation (Shirvell 1990, Meehan and Bjornn 1991). Salmonid juveniles will balance their use of cover and foraging habitats based on their competing needs for energy acquisition and safety (Bradford and Higgins 2001). Critical forms of cover include submerged vegetation, woody debris, and the interstitial spaces of streambed gravel substrate (Raleigh *et al.* 1984). Steelhead juveniles will respond to threats of predation, including overhead motions, by huddling together or fleeing to nearby cover (Bugert and Bjornn 1991). Few young-of-the-year are found more than one meter from cover (Raleigh *et al.* 1984). Juvenile steelhead, particularly the younger, smaller individuals, have a notably docile response to disturbance; they rely on

nearby substrate particles (*i.e.*, gravel) for cover more than other salmonids (Chapman and Bjornn 1969, Everest and Chapman 1972, Wesche 1974).

Frequently disturbed stream channels have relatively less abundance and diversity of cover habitat for juvenile salmonids, and hiding in substrate pores may be the main response to threats (Chapman and Bjornn 1969, Everest and Chapman 1972, Wesche 1974). Even where other forms of cover are present, young-of-the-year salmonids will respond to noise, movement, and other disturbances by entering pore spaces in the streambed at riffles (Shirvell 1990, Meehan and Bjornn 1991).

As described above, NC steelhead is the listed species most likely to be present in the edgewater and side channel habitat during the construction of the berm (Halligan 2002). Since the footprint of the berm is an important habitat for steelhead fry, it is likely that due to the timing of the action, a portion of the juveniles present in the footprint location would take cover within the gravel and be crushed by equipment or the berm fill. Therefore, due to the propensity of salmonid fry to seek shelter in substrate, it is unlikely the tactics proposed to disperse steelhead fry from the footprint of the berm will completely protect fish from crushing. The number of fish killed during this aspect of the Proposed Action is dependent upon a number of factors including timing, duration, and abundance of fish species. For example, the later in the year the berm is constructed, the larger the listed juvenile salmonids will be, and the less likely they will be to take refuge within the substrate. Further, the abundance of juveniles in the area may vary widely. Halligan (2002) hypothesized that an increase in wetted habitat within the footprint of the berm resulted in a greater abundance of steelhead fry in 2002. Further, attempts at estimating an accurate abundance of fish in the construction site are confounded by limitations of observing fish in shallow-water habitat. Halligan observed 165 steelhead fry in shallow water habitat, located in, and adjacent to the berm construction site in 2002, using snorkel and stream-side observations. However, his rescue efforts during berm construction resulted in relocating 231 steelhead fry. This indicates a portion of the steelhead fry residing in shallow water habitat were not observed during snorkeling and stream-side observations. In comparison, the abundance of juvenile salmonids prior to the construction of the berm was lower in 2003 than in 2002. Halligan observed 55 young-of-the-year steelhead, 26 one-year old and older juvenile steelhead, and 67 juvenile Chinook salmon in a 4,000-foot reach of the Mad River that included the berm construction site (Halligan 2003).

The duration of the berm construction may also influence the amount and extent of take of listed fish. Halligan (2002) recommends constructing the berm slowly to allow for more opportunities to rescue fish. However, by constructing the berm slowly, Halligan (2002) predicts there will be a greater duration of sediment and turbidity delivered to the Mad River. Effects of sediment delivery and turbidity associated with the construction of the berm are analyzed below in part “d(4)” of the *Effects Section*.

NMFS anticipates an unquantified amount of steelhead fry present during construction activities will seek refuge within the substrate. Some of these fish may die while heavy equipment is transported through wetted portions of the channel or while the berm is being constructed and

gravel is mounded in the wetted channel. Larger juveniles are less prone to crushing. They will likely flee the area because the substrate size is not large enough to provide cover for them. However, these juveniles could flee into areas of higher predator concentration or lower quality instream habitat.

(3) Long- and short-term alteration of physical habitat. The District proposes to dewater and cover a portion of a riffle/pool segment of the Mad River with gravel to increase the water surface elevation by constricting the channel of the Mad River. The District may also utilize gravel directly downstream and upslope of the proposed berm site for the berm construction. The berm will remain in place until annual winter flows mobilize and transport the berm fill.

The placement of gravel over a portion of the Mad River will result in a temporary, *i.e.*, approximately late-May through December, loss of habitat that could otherwise be used by salmonids. Halligan (2003) observed a reduction in area of two habitat units following the construction of the berm. While the exact amount of habitat affected is unknown, the relatively low abundance of SONCC coho salmon, CC Chinook salmon, and NC steelhead observed immediately before, during, and after construction indicates few fish were likely affected by this activity, and rearing habitat in the immediate vicinity of the berm did not appear to be limiting during these observations.

The effect of relocating gravel from one portion of the bar and placing it upstream to form the berm has not been analyzed by the District. The District has used river-run gravel from the dredging activities as material for the berm construction. However, upon CDFG's recommendations, the District ceased using river-run gravel for berm construction in 2001. Removing gravel from bars (*i.e.*, skimming) can affect channel form and function. By lowering the height of bars, a channel is at risk of: (1) losing pool habitat by increasing the width to depth ratio of the river, (2) increased riffle instability and migration blockage at riffles, and (3) losing established riparian vegetation. As a means of maintaining the integrity of the bar and adjacent channel morphology, NMFS and the District agreed to avoid using gravel located below the silt line.

The proposed berm location is within a portion of the Mad River mined for gravel, and in turn, is a disturbed reach of river lacking the morphological form and hydrological function of a healthy river system. NMFS expects the District's proposed action will prolong the recovery of instream habitat adjacent to, and directly downstream of Station 6 Facility for a distance of approximately a 1/4 mile, until a long-term solution is implemented. Consequently, the utilization of this portion of the Mad River by listed salmonids as rearing, holding, and spawning habitat will not likely improve in the near future.

(4) Sediment delivery and increased turbidity to the Mad River. Project activities associated with berm construction and construction of the trench have the potential to introduce sediment and turbidity into the action area to a level that could adversely affect listed salmonids. In previous years, the District has conducted both berm construction activities and trenching activities simultaneously. Therefore, rather than analyze these actions separately as they affect

sediment delivery and increased turbidity, we will analyze the effects of sediment delivery and increased turbidity for both berm construction and dredging activities cumulatively.

In 2002, the District attempted to minimize the extent of sediment delivery to the Mad River by constructing the berm quickly (<4 hours). A result of the rapid timeline of construction was a rapid dewatering of an associated side channel. As a result, fish rescue efforts were unable to relocate fish in a timely manner, and 48 steelhead fry died from suffocation. Halligan (2002) recommended extending the duration to construct the berm in an effort to reduce mortality during fish relocation. In 2003, the duration of the trenching and berm construction activities lasted approximately 6 hours, however the density of listed juveniles adjacent to the berm site was much lower in 2003 than 2002, thus, no conclusion can be drawn concerning minimizing juvenile mortality by constructing the berm slowly.

Sediment associated with these actions will also be delivered to the Mad River during winter high flows. Decompacted gravel and fill resulting from these actions will erode at a high rate when inundated by stream flows, and increase the level of turbidity and suspended sediments downstream.

The responses of juvenile salmonids to increased turbidity range from behavioral (avoidance), to rapid mortality (Newcombe and Jensen 1996). For example, juvenile salmonids subjected to a concentration of 8100 mg/L of suspended sediment for up to 1-day suffered sub-lethal effects, but after 2 days, experienced 20% mortality. High turbidity concentrations can cause fish mortality, alter production of macro-invertebrates, reduce fish feeding efficiency (Sigler *et al.* 1984), and decrease food availability (Newcombe and Jensen 1996). Substantial sedimentation rates could bury less mobile organisms that serve as a food source for many fish species, degrade in-stream habitat conditions, and cause reductions in fish abundance and growth (Bjornn *et al.* 1977). Increased sedimentation of substrate can decrease the habitat quality of spawning and rearing areas (Chapman 1988, Lisle 1989) and reduce pool volumes (Lisle and Hilton 1991). Excess sediment can also reduce feeding opportunities of fish (Berkman and Rabeni 1987), preclude fish from cover (Hillman *et al.* 1987), decrease survival to emergence of young salmonids (Bjornn *et al.* 1977), and degrade the quality and quantity of in-stream habitat (Bjornn *et al.* 1977, Hillman *et al.* 1987, Nielsen *et al.* 1994). When background turbidity levels are normally low, suspended sediment can cloud otherwise clear water making salmonid prey and predator detection difficult.

During the 2003 construction, the District monitored turbidity throughout a 1,500 foot portion of the Mad River downstream of the construction of the berm and trench. Background turbidity levels were approximately 0.9 NTU. Turbidity levels associated with construction activities were significantly greater in portions of the channel directly downstream of the construction site. A maximum level of 14.3 NTU was observed approximately 50 feet downstream of the berm construction site, while a maximum of 3.4 NTU was observed approximately 1,000 feet downstream of the berm construction site. Turbidity levels at all sites decreased to background levels within 16 hours following the completion of construction.

Adult summer steelhead may be present in the berm construction and trench area during construction activities. Complex pool and run habitat directly downstream of Station 6 Facility provide opportunities for adult summer steelhead to hold. A series of bedrock formed pools exist downstream of the construction site, including one of the larger bedrock controlled pools in the lower Mad River. These deep water habitats provides opportunities for summer steelhead to hold. The likelihood that adult steelhead may be affected by a reduction in water quality from construction activities will be directly correlated to the proximity of adult steelhead to the construction site. Those fish directly downstream of the construction will experience the greatest impacts. As the plume of turbid water moves downstream, suspended sediment will settle out, and consequently, those individuals farther downstream will be less affected. Adult steelhead immediately adjacent to and up to approximately 1/4 mile downstream of the construction site will experience a short-term (<24 hours) increase in turbidity, as well as disturbance in and around the construction area. Adult steelhead may avoid the construction area for a short period of time, resulting in migration delay. NMFS anticipates the potential short-term adverse effect of sediment inhibiting adult steelhead migration will not extend beyond a 24-hour period, and will be greatest during the early phase of construction. As flows winnow the fines from the face of the exposed berm, turbidity will decrease.

As sediment settles downstream of the construction sites, adult spawning habitat for salmonids that spawn in the action area will likely be temporarily degraded. The fine sediment that settles in pool tails and heads of riffles will not be flushed until fall rains occur. In the event of a dry fall, early season spawners (*i.e.*, fall Chinook salmon) that would utilize mainstem spawning habitat during low flow conditions may experience reduced spawning success until these actions are replaced by a long-term solution (potentially in 5 years).

Juvenile salmonids adjacent to or up to approximately 1/4 mile downstream of the berm and trench area will experience an impact to their feeding ability. Food resources, including aquatic insects and marine invertebrates, important as food sources for juvenile salmonids, could be harmed by the loss of habitat as sediment settles into the interstitial spaces of coarse substrate. The magnitude of this impact will be directly correlated to the proximity of juvenile salmonids and their prey to the construction site. Those fish directly downstream of the construction will experience the greatest impacts. Project-related sediment transported to and settled in salmonid habitat could further diminish the value of already degraded habitat. Interstitial spaces may fill, reducing the velocity refugia. Pools can fill with additional sediment, thereby limiting the space available for rearing salmonids. Fine sediment that settles from these described actions will be retained until flushing flows occur.

Summary

Based on construction in previous years, the duration of the dredging and berm construction activity is anticipated to be no more than eight hours. NMFS anticipates a short-term (<24 hours) increase in turbidity to occur as a result of these actions, with the greatest impacts expected directly downstream of the construction site. Most suspended sediment will settle out within a half mile from the construction site. Given the short duration of this action, and

monitoring results from the 2003 construction, NMFS anticipates that the adverse effects of turbidity will diminish and become negligible within 24 hours. However, for the 8-hour period of construction and approximately 16-hour period of sediment settling out from combined dredging and berm construction activities, NMFS anticipates that downstream of the construction site there will be (1) a reduced efficiency in feeding among juvenile salmonids, and (2) behavioral impacts such as avoidance and hindrance to migration in both juvenile salmonids and adult summer steelhead. Within the 1/4-mile area of the Mad River that will likely be affected by this construction, conceivably hundreds of juvenile salmonids could be present at a given time. Based on monitoring studies of adult summer steelhead in previous years, it is unlikely more than 10 adult steelhead will be present in this 1/4-mile reach. NMFS does not anticipate the effects of increased turbidity resulting from berm and trench construction activities will rise to a lethal level to these fish, and fish are expected to recover from these effects shortly thereafter.

Construction activities that could degrade critical habitat for SONCC coho salmon will occur. The function of the critical habitat within the action area includes rearing habitat suitable for feeding and sheltering. Halligan (2003) documented coho salmon juveniles utilizing habitat in the action area, associated with pool habitat and either instream or overhanging vegetation providing cover. Coho salmon also use the action area as a migratory route to and from spawning areas. However, due to the preference of coho salmon to spawn in tributaries, and the general lack of suitable coho salmon spawning habitat, NMFS does not believe coho salmon utilize the area adjacent and downstream of Station 6 Facility for spawning on a regular basis.

Sediment delivery will have a longer-term effect on the quality of spawning and rearing habitat than will elevated turbidity. During the 2002 construction, the District observed most sediment had settled out downstream by the Highway 299 bridge (approximately 2,000 feet) (pers. comm., B. Van Sickle, Operations Manager, District, April 2003). NMFS anticipates a small amount of sediment resulting from the berm construction and dredging actions may settle into spawning areas within the action area potentially reducing the spawning success of those listed salmonids utilizing the 1/4-mile section of the river most affected by disturbance. The ability of salmonids to spawn and rear in this reach of the Mad River may be adversely affected until flows are sufficient to mobilize and transport sediment, approximately in mid-October. Spawning potential in the lower Mad River may be especially important for early season Chinook salmon during periods of drought due to the inability of these fish to access more favorable spawning habitat upstream of Station 6 Facility.

When considering the context of the range of the three listed salmonid ESUs, the importance of the action area to these three ESUs, the limited area of disturbance, and the short-term degradation of water quality associated with these actions, NMFS expects the sediment delivery and turbidity associated with these actions to result in a small reduction in the Mad River CC Chinook salmon spawning success for approximately the next 5 years, until long-term solutions to the construction of the trench and berm are implemented

(5) Fuel and hazardous contaminant spill. Spills of petroleum products during fueling of machinery may occur. These contaminants could adversely affect listed salmonids, their habitat, and forage if they are delivered to the action area. However, the District requires the use of relevant Best Management Practices, a Water Pollution Control Plan, and emergency spill control measures. The District requires contractors to exercise every reasonable precaution to protect the stream from fuel or oil spills. Equipment fueling is required to occur outside of the bankfull channel. All equipment is pressure washed and inspected for leaks prior to entering the river bed. Spill containment kits are readily available at the work site. These practices virtually eliminate the likelihood of petroleum products fuels entering aquatic habitat. Therefore, NMFS expects adverse effects to listed salmonids or their habitat due to petroleum product contamination to be unlikely to occur.

e. Maintain adequate flow to direct diversion facility

The District proposes to excavate a trench in the Mad River, upstream of the Station 6 Facility, to ensure that flow can enter Station 6. Excavation is proposed to occur in late May through early June until a long-term solution for maintaining flow to Station 6 Facility is developed (in approximately 5 years). Construction of the trench each year will be completed within 4-6 hours. The excavated area depends on the extent of accumulated gravel formed over the high flow season. In years past, the area of excavation has varied. In 2002 and 2003, the trench was constructed predominately outside of the wetted channel, then connected to the wetted channel at the upstream end. In other years, the trench was constructed completely in the wetted channel. The effects of this action will vary according to a number of factors which are presently unknown: the extent of excavation, the presence of fish, and the location of the trench (*i.e.*, dry or wet channel).

Construction of the trench could result in the following:

- (1) Crushing of juvenile salmonids as a result of dredging activities.
- (2) Short-term alteration of instream habitat at the diversion inlet.
- (3) Sediment delivery and increased turbidity to the Mad River.
- (4) Fuel and hazardous contaminant spills.

The effects of sediment delivery and increased turbidity as well as fuel and hazardous contaminant spills on listed salmonids have been analyzed previously. Therefore, these effects from this action on listed salmonids will not be analyzed further.

(1) Crushing of juvenile salmonids as a result of dredging activities. Little information has been provided to NMFS to indicate the abundance or distribution of fish that may be encountered in the dredging area. Prior to 2003, monitoring activities investigating fish abundance focused on the berm construction site rather than the trench excavation site. In 2003, no salmonids were observed in the footprint of the trench before or during construction.

The excavation will connect a glide-type habitat upstream of the Station 6 Facility to the pool-type habitat directly in front of the forebay. The glide-type habitat was described in 1995 as

containing poor habitat complexity, approximately one-half feet deep during summer low-flows (Trinity Associates 1995). The amount of wetted habitat that will be disturbed will depend on a number of factors, including the location of the thalweg and the extent of aggradation upstream of the Station 6 Facility. As described in the Proposed Action, the configuration and extent of the trench will vary depending on: (1) the amount of material which has aggraded in front of Station 6, and (2) the location of the aggraded material in relation to the low-flow channel of the river. In previous years, the area of excavated sediment ranged from 250–500 feet by 20 feet (5,000–10,000 square feet). Therefore, the amount of habitat affected by this action will vary. The trench will remain until sediment fills in each year during winter stream flows. In 2002 and 2003, approximately, 3,000 square feet of wetted channel were disturbed during construction.

Steelhead fry are the listed species and life history stage most likely to inhabit this area at the time of excavation; however, Chinook and coho salmon juveniles may also be present. As described above, juvenile salmonids occupy shallow-water habitat. They remain in these rearing areas throughout the summer, with some shift in habitat use as they age and as conditions change (Chapman and Bjornn 1969). Steelhead juveniles respond to threats of predation, including overhead motions, by huddling together or fleeing to nearby cover (Bugert and Bjornn 1991). Juvenile steelhead, particularly the younger, smaller individuals, have a notably docile response to disturbance; they rely on nearby substrate particles (*i.e.*, gravel) for cover more than other salmonids (Chapman and Bjornn 1969, Everest and Chapman 1972, Wesche 1974).

Frequently-disturbed stream channels have relatively less abundance and diversity of cover habitat for juvenile salmonids than similar undisturbed stream channels. Therefore, in sediment removal areas, hiding in substrate pores may be the main response to threats (Chapman and Bjornn 1969, Everest and Chapman 1972, Wesche 1974). Even where other forms of cover are present, young-of-the-year salmonids will respond to noise, movement, and other disturbances by entering pore spaces in the streambed at riffles (Shirvell 1990, Meehan and Bjornn 1991).

The District proposes to use an excavator to dredge the channel and direct flow to Station 6 Facility. The District proposes to minimize the extent of heavy equipment entering the active channel; however, if required, the excavator may be located in a shallow water section of the Mad River. Because this is an important habitat for salmonid juveniles (Bradford and Higgins 2001), it is likely that juveniles will be present, and that some of them in the path of equipment will take cover within the gravel and be crushed as equipment passes over. Additionally, other juvenile salmonids will become stranded in the extracted gravel and die as a result of excavation. Larger juveniles are less prone to crushing from equipment crossings. They will likely flee the area because the substrate size is not large enough to provide them cover. However, these juveniles could flee into areas of higher predator concentration (*i.e.*, deep water habitat adjacent and downstream where avian predators and two-year-old steelhead reside) or lower quality instream habitat.

(2) Short-term alteration of instream habitat at the diversion inlet. Until a long-term solution is implemented to ensure adequate flow to Station 6 Facility, the District estimates approximately 2,000 cubic yards of material will be excavated annually from the Mad River to

construct the trench. The dimensions of the trench will be 250-500 feet long, and 20 feet wide (0.11-0.23 acres). The depth and configuration of the resulting trench will be dependent upon the amount of sediment stored in front of Station 6 and the location and morphology of the river. Gravel extracted for this purpose is stored upslope of the trench and within the floodplain of the river.

Short-term habitat change will occur as a result of this action. These include changes in substrate composition, changes in habitat parameters (*i.e.*, depth, velocity), and changes in the abundance and composition of macroinvertebrates (Behnke *et al.* 1987). Immature mayflies (*Ephemeroptera*), stoneflies (*Plecoptera*), and caddisflies (*Trichoptera*, referred to collectively as EPT), are the most productive, preferred, and abundant of foods available to stream fishes (Waters 1995), and can be adversely affected by sediment removal (Behnke *et al.* 1987). The EPT group typically inhabit the interstitial spaces of coarse substrate in the wetted channel. Sands and silt are the least productive substrates for aquatic macroinvertebrates (Hynes 1970) and are more easily mobilized, making them unsuitable because they are less stable (Fields 1982). Direct loss of aquatic macro-invertebrates will likely result when organisms are buried or crushed during the construction of the trench in the wetted channel. Localized losses in benthic macro-invertebrate abundance are expected when substrates are modified (Thomas 1985; Harvey 1986). The effect of macro-invertebrate loss on salmonids is likely to be temporary and minor, because rapid re-colonization of the disturbed areas is expected and the small footprint of gravel placement. Reported rates of recolonization range from about one month (Thomas 1985) to 45 days (Harvey 1986). Since the reduction in food productivity will be minor in scale and short duration, NMFS does not anticipate any adverse effects to listed salmonids due to a reduction in food availability.

Trenching of low-flow channels has also been reported as a benefit to anadromous salmonids in the form of deep water pool refugia (USACE 1999). Trenched pools, however, are often devoid of cover and not suitable for rearing juvenile salmonids that require refuge from predators. Since shallow water habitat does not appear to be limited in the construction area, it is unlikely that the change in habitat from shallow glide to trench will result in an adverse affect to listed salmonids.

2. Current activities which occur only as-needed

a. Maintaining adequate capacity in tailrace and spillway pools below Matthews Dam.

The use of heavy equipment (*e.g.*, excavator) to remove aggraded material and sediment from the tailrace channel and spillway plunge pool may affect listed salmonids in the following manner:

- (1) Injuring or killing fish through the use of heavy equipment in the water column.
- (2) Short-term reductions in water quality in the Mad River.

(1) Injuring or killing fish through the use of heavy equipment in the water column. Due to the hindrances to migration downstream of Matthews Dam (RM 84), it is very unlikely that adult salmonids will be located in the tailrace and spillway plunge pool. A series of boulder falls below Deer Creek (RM 50-53) creates a barrier to migration of adult salmonids except during

small hydrologic windows (CDFG 2002). While large numbers of summer steelhead have been counted below Deer Creek, over the last three years, a declining number of steelhead have been able to negotiate this barrier. In 1998, only four fish were observed in the upper Mad River, where Six Rivers National Forest maintains its index reach. The unstable geology from Wilson Creek through to Showers Creek makes fish passage uncertain, in any given year, depending on channel and flow conditions. Therefore, NMFS anticipates there is a minimal risk of injuring listed adult salmonids from heavy equipment operation in the tailrace and plunge pool spillway.

(2) Short-term reductions in water quality in the Mad River. The short-term effects to water quality associated with the use of heavy equipment in the stream channel are discussed in detail above. A short pulse of turbidity is expected from this action, lasting no more than 24 hours beyond the instream maintenance activities. Fine sediments are expected to settle out within a mile downstream of Matthews Dam. The value of this area of the Mad River to SONCC coho critical habitat is to provide adequate water quality downstream. NMFS expects that any sediment affecting water quality from this action will be diluted by downstream accretions or will have settled out before it can affect habitat occupied by coho salmon at or below RM 53.

b. Gain access to and maintain Ranney Collectors.

Maintenance of the District's Ranney Collectors would occur, as needed, during low flow, dry conditions. Ranney collector maintenance will result in the disturbance of the Mad River bed, however, the District proposes to conduct all activities on dry river bed surface. The disturbance of native gravel to gain access to the Ranney Collectors will disrupt the armoring of surface material and result in a release of fine sediments during the first flow inundation. The District proposes to re-grade the river bar to its original configuration.

Flushing activities will occur into a gravel sump with a gravel berm constructed around the perimeter to capture all fine sediments. The river bed will then be re-graded, burying any significant fine sediments released in flushing activities.

NMFS anticipates a minor increase in turbidity when flows inundate the disturbed river bed. However, the resulting increase in turbidity as a result of this action is expected to be negligible. NMFS anticipates that listed salmonids will not experience adverse effects as a result of this action. Also, NMFS does not expect that the insignificant increase in sediment and turbidity is likely to adversely affect designated critical habitat for SONCC coho salmon.

c. Repair of Rock Structures and Revetment.

Rock and revetment repair activities may include moving rocks with heavy equipment. The following are actions associated with this activity that may affect listed Pacific salmonids or SONCC coho salmon designated critical habitat:

- (1) Fuel and other hazardous contaminant spills.
- (2) Sediment delivery and increased turbidity to the Mad River.

(1) Fuel and other hazardous contaminant spills. The risk of fuel and hazardous contaminants on listed salmonids has been previously analyzed and will not be discussed further.

(2) Sediment delivery and increased turbidity to the Mad River. NMFS anticipates the District's proposed use of geo-textile and natural vegetative matting in and around areas of disturbed river bar will reduce the amount of erosion and sediment delivery from rock structure and revetment repair work. The timing of the repair work will coincide with dry, low-flow conditions; therefore, any sediment delivery and turbidity resulting from this action will occur during periods of heavy rain when the project area is inundated by high flows and ambient sediment levels are already high as a result of the heavy rains. Therefore, sediment delivery associated with the project will not be detectable above the ambient levels found in the river when sediment delivery occurs. Heavy equipment is not expected to enter the stream channel. We expect the effects of this action will be negligible to listed salmonid species and designated critical habitat for SONCC coho salmon.

VIII. CUMULATIVE EFFECTS

Cumulative effects are defined in 50 CFR § 402.02 as "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." Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultations pursuant to section 7 of the ESA.

Until improvements in private land management practices are actually implemented, NMFS assumes that future private and State actions will continue at similar intensities as in recent years, and that habitat for Pacific salmonids will continue to be degraded. Timber harvest, agriculture, urbanization, and road building, have resulted in degraded habitats. These impacts have substantially reduced survival of Pacific salmonids in many river reaches.

Timberland management in the upper watersheds of the Mad River Basin will continue under the California State Forest Practice Rules. Even if timber management were to cease, some level of effect from previous timberland management will continue to manifest downstream in the action area due to temporal delays in hillslope processes and routing of sediments stored in stream channels.

Agricultural practices that may affect the action area are expected to continue. Future land use depends most likely on the flood risk and the proximity to developed roads of any given parcel. Some existing restrictions, such as Federal Emergency Management Agency flood insurance restrictions and/or the Regional Water Quality Control Board septic tank restrictions, may reduce the potential risk of impacts from developments in the action area.

IX. INTEGRATION AND SYNTHESIS OF EFFECTS

Issuance of a 50-year ITP and implementation of the HCP will result in changes to channel form and function, and these changes affect habitat function for salmonids as described above. These channel and habitat changes include seasonal simplification of habitat due to the following actions: berm construction, trench construction, excavation of the area directly in front of the forebay, excavation of the area directly downstream of Matthews Dam. Short term reductions in water quality are also expected as a result of these actions. Several activities proposed by the District will result in negligible impacts to salmonids and their habitat. The maintenance of the tailrace and spillway pool is expected to have negligible impacts given the current distribution of salmonids and the infrequency of activities (approximately every ten to fifteen years). Gaining access to the Ranney collectors for infrequent maintenance is expected to have negligible impacts since the work would occur on the dry bar, not result in any appreciable modification of the bar form, and not cause discharge of any turbid water to the adjacent wetted channel. Similarly, maintenance of existing rock structures at the District's facilities would occur infrequently in response to large storms and be limited to localized sites described in the HCP and not result in appreciable changes in the river or associated habitat. NMFS also anticipates beneficial effects to listed salmonids resulting from the Proposed Action. The operation of Matthews Dam will continue to supply augmented flows and improved water quality over an 85-mile stretch of river from Matthews Dam to Essex Station 6 Facility. Project effects relative to SONCC coho salmon, CC Chinook salmon, and NC steelhead freshwater habitat and life history stages (*i.e.*, spawning, migration, rearing, feeding and holding) are discussed in the above sections, and summarized below. NMFS anticipates these effects will be reduced as long-term solutions to water delivery at Station 6 are developed and implemented by the District.

Spawning Habitat

Fine sediment resulting from maintenance activities are expected to decrease the quality and quantity of salmon and steelhead spawning habitat for a short-term period (less than 3 months) in the Mad River from Station 6 Facility to a point approximately 1/4 mile downstream, resulting in a potential reduction to salmonid spawning success within this reach of stream. Spawning success is most likely to be affected during years of low fall and early winter rainfall when upstream passage of adult salmonids is impeded by low flow conditions. NMFS expects the implementation of long-term solutions to the construction of the trench and berm will reduce the amount of fine sediment delivery associated with District operations. The implementation of long-term solutions to the berm and trench are anticipated in approximately 5 years.

Rearing and Holding Habitat

NMFS expects that a result of the berm construction, dredging in and around the forebay, excavation directly below Matthews Dam, and trench construction activities will be a reduction in the quality of water over a 24-hour period during and following each activity. Juvenile salmonids may experience reduced feeding efficiency, and juvenile salmonids and adult summer-run steelhead may experience physiological stress from turbid conditions for a short period of time and likely recover. Fine sediment that settles into interstitial zones may degrade the habitat of macroinvertebrates and have an indirect adverse effect on the health of juvenile salmonids by

reducing the quality and/or quantity of prey. NMFS expects this impact to persist until higher flows mobilize this sediment downstream, eventually washing it from the system. NMFS expects these flushing flows to occur during fall or early winter; therefore, the potential effects of activities scheduled for early summer (*i.e.*, trench and berm construction) will persist for approximately 6 months, annually. However, due to the low abundance of juvenile salmonids inhabiting the lower Mad River in summer, NMFS expects this effect on listed salmonids will be minimal. NMFS expects the implementation of long-term solutions to the construction of the trench and berm will reduce the amount of fine sediment delivery associated with District operations. The implementation of long-term solutions to the berm and trench are anticipated in approximately 5 years.

As a result of augmented flows, NMFS anticipates there will be an improvement over baseline, in available rearing and holding habitat for juvenile and adult salmonids. Upstream fish passage for adult salmonids will likely be improved year-round above Station 6 Facility as a result of increased flows relative to the unimpaired hydrology. Further, augmented flows will likely reduce the transit time of juveniles year-round from upstream locations to the Station 6 Facility location. During some periods of the year, cold water releases from Matthews Dam will result in improvements to water quality in the upper and middle zones, however, due to a series of boulder falls in the Deer Creek region, listed salmonids may not experience much, if any benefit from the improvements to water quality.

NMFS anticipates that an unknown quantity of salmonid fry will be killed as a result of the annual construction of the berm and trench, from dredging activities, and from the operation of the fish screen. Given the scope of work associated with the Project, monitoring data indicating the impact of prior years of operation, and the variables which will influence the amount or extent of adverse effects and take, NMFS anticipates a relatively small number of juvenile salmonids will be killed. Steelhead fry are the species and life history phase most likely to be present in the construction sites, and in turn, the species and life history most likely to be affected by construction activities. To a lesser degree, juvenile coho salmon and Chinook salmon may also be killed by construction actions. The number of individuals killed annually will decrease with the implementation of long-term solutions of the berm and trench.

The survivability rate of salmonid fry is naturally very low. Studies have been conducted on the survival rates of salmonids through their life history stages. For example, Godfrey (1965) found that the published values for fry to smolt survival of coho salmon ranged from 0.7-9.65% with the average being 1.27-1.71%. Similarly, Neave and Wickett (1953) estimated survival of coho salmon from egg to smolt between 1% and 2% with the majority of mortality occurring in the first summer. Smolt to adult survival has also been studied. For example, Shapovalov and Taft (1954) observed survival rates of coho salmon from smolt to adult ranging from 0.98% to 7.72% with a mean of 4.95%. Mathews and Buckley (1976) estimated that, after the first six months of ocean life, 13% of smolts survived, and approximately 4% of the smolts that had migrated to sea returned to spawn.

Steelhead fry may be killed and never quantified because a portion of steelhead fry that seek refuge in the substrate will never be found. Using a conservative estimate of the survivability of salmonid fry to returning adults, NMFS expects the mortality of steelhead fry is unlikely to exceed 200 fish annually during construction activities, resulting in a loss of no more than two returning adult steelhead (given a 1% fry to returning adult survival rate) to the Mad River annually until construction activities are ceased in approximately 5 years.

The effects of operating the Station 6 Facility fish screens will also result in the take of coho salmon, Chinook salmon, and steelhead. A conservative estimate, given Trinity Associates (1999) study and the assumption that run sizes will be substantially greater in the future than 1998, would still result in a low number of juvenile take. NMFS anticipates no more than 50 juvenile salmonids of each species will die, annually for the next 50 years, as a result of operating the fish screens at the Station 6 Facility.

While take of individuals is expected to occur from Project activities, the beneficial effects associated with Project activities (*e.g.*, augmented flows) is expected to ameliorate those adverse effects to listed salmonid populations. As a result, the loss of the individuals potentially harmed or killed as a result of these actions is not expected to reduce the numbers, reproduction, or distribution of any of the populations of the three listed salmonid ESUs addressed in this Opinion. Therefore, we do not expect a reduction in the likelihood of both the survival and recovery of listed salmonids at the population or ESU scale. NMFS does not anticipate that SONCC coho salmon designated critical habitat will be adversely modified or destroyed due to the short portion (approximately 5 years) of the HCP period that we anticipate the annual construction of the berm and trench will continue and the relatively small area that may be affected by these actions.

X. CONCLUSION

After reviewing the best scientific and commercial data available, the current status of SONCC coho salmon and their designated critical habitat, CC Chinook salmon, and NC steelhead, the environmental baseline for the action area, the effects of the District's Maintenance Activities, and the cumulative effects, it is NMFS' biological opinion that our issuance of an Incidental Take Permit to the District for its operations pursuant to the HCP is not likely to jeopardize the continued existence of SONCC coho salmon, CC Chinook salmon, or NC steelhead and is not likely to destroy or adversely modify designated SONCC coho salmon critical habitat.

XI. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without 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 [ESA section 18(3)]. Harm is further defined by NMFS as an act

which kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering (November 8, 1999, 64 FR 60727). Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

The proposed Humboldt Bay Municipal Water District's HCP for Mad River Operations and its associated documents clearly identify anticipated impacts to affected species likely to result from the proposed taking and the measures that are necessary and appropriate to minimize those impacts. All conservation measures described in the proposed HCP, together with the terms and conditions described in any associated Implementing Agreement and any section 10(a)(1)(B) permit or permits issued with respect to the proposed HCP, are hereby incorporated by reference as reasonable and prudent measures and terms and conditions within this Incidental Take Statement pursuant to 50 CFR §402.14(I). Such terms and conditions are non-discretionary and must be undertaken for the exemptions under section 10(a)(1)(B) and section 7(o)(2) of the Act to apply. If the permittee fails to adhere to these terms and conditions, the protective coverage of the section 10(a)(1)(B) permit and section 7(o)(2) may lapse. The reporting requirements, and provisions for disposition of dead or injured animals are as described in section 9 of the HCP and its accompanying section 10(a)(1)(B) permits. The amount or extent of incidental take anticipated under the proposed Humboldt Bay Municipal Water District's HCP for Mad River Operations are described in Tables 6 and 7 of the HCP. Because precisely quantifying take associated with many of the proposed activities described in Tables 6 and 7 of the HCP is impossible, NMFS has focused on the take associated with the various activities at Station 6 as the quantifiable trigger for reinitiation of consultation. Take associated with the screens at Station 6 will not exceed 5% of the exposed juvenile population in any given year or 3% of the exposed juvenile population over four consecutive years, as determined from the annual monitoring program described on pages 40-46 in the HCP.

XII. REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the proposed action. As provided in 50 CFR§ 402.16, reinitiation of formal consultation is required where discretionary Federal involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded, (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered in this opinion, (3) the action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, formal consultation shall be reinitiated immediately.

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