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

AUG 27 2015 **Refer to NMFS No:** WCR-2015-2716

Jane M. Hicks
Chief, Regulatory Division
Department of the Army
San Francisco District, U.S Army Corps of Engineers
1455 Market Street
San Francisco, California 94103

Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Letters of Permission for Gravel Extraction in Humboldt County (LOP 2015-1) and the Hoopa Valley Tribe's Individual Permit for gravel extraction (2015-2025)

Dear Ms. Hicks:

Thank you for your letter of April 3, 2015, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 *et seq*.) for an 11-year Letter of Permission for Gravel Extraction in Humboldt County (LOP 2015-1) and for the Hoopa Valley Tribe's (HVT) 11-year individual permit (2015-2025).

NMFS has decided to batch the LOP 2015 and the HVT's individual permit biological opinions because of significant similarities in the proposed actions and overlap in some of the action area (Trinity River). The batched biological opinion is based on NMFS' review of the information provided within the consultation initiation package submitted on April 3, 2015, by the U.S. Army Corps of Engineers (Corps). The batched biological opinion addresses potential adverse effects on Evolutionarily Significant Units (ESU) or Distinct Population Segments (DPS) and the designated critical habitat of the following federally listed species:

Southern Oregon/Northern California Coast (SONCC) coho salmon ESU
(Oncorhynchus kisutch)
Threatened (70 FR 37160, June 28, 2005)
Designated Critical Habitat (64 FR 24049, May 5, 2009)

California Coastal Chinook (CC) salmon ESU
(O. tsawytcha)
Threatened (70 FR 37160, June 28 2005)
Designated Critical Habitat (70 FR 52488, September 2, 2005)

Northern California (NC) steelhead DPS
(O. mykiss)
Threatened (71 FR 834, January 5, 2006)
Designated Critical Habitat (70 FR 42488, September 2, 2005).

Based on NMFS' review of the consultation initiation packages and the best scientific information available, NMFS concurs with the Corps determinations that the actions, as proposed, are not likely to jeopardize the continued existence of SONCC coho salmon, CC Chinook salmon, and NC steelhead and is not likely to result in the destruction or adverse modification of the designated critical habitats for the aforementioned species.

NMFS' expects the proposed actions will result in the incidental take of SONCC coho salmon, CC Chinook, and NC steelhead. An incidental take statement is included with the enclosed batched biological opinion for each individual proposed action (LOP 2015 and the HVT's individual permit). The incidental take statements include non-discretionary reasonable and prudent measures and terms and conditions that are expected to further reduce incidental take of SONCC coho salmon, CC Chinook, and NC steelhead as a result of the proposed action.

The enclosed Essential Fish Habitat (EFH) Response consultations were prepared pursuant to section 305(b) of the Magnuson Stevens Fishery Conservation and Management Act. The proposed action includes areas identified as EFH for coho salmon and Chinook salmon, which are Pacific Salmon species managed under the Pacific Coast Salmon Fishery Management Plan. NMFS concludes that the projects would adversely affect EFH for coho salmon and Chinook salmon. However, the proposed actions contain adequate measures to avoid, minimize, and mitigate the adverse effects to EFH. Thus, no additional EFH Conservation Recommendations are requested by NMFS.

Please contact Mitch Markey, Northern California Office, Arcata, California at (707) 825-1620 or mitch.markey@noaa.gov, if you have any questions concerning the LOP 2015 section 7 consultation, or Dan Free at (7-7) 825-5164 or Dan.Free@noaa.gov, if you have questions regarding the HVT's section 7 consultation, or if you require additional information.

Sincerely,

Barry Thom for

William W. Stelle, Jr.
Regional Administrator

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

Letters of Permission for Gravel Extraction in Humboldt County (LOP 2015-1)

NMFS Consultation Number: *WCR-2015-2716*
Action Agency: *United States Army Corps of Engineers*

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species or Critical Habitat?*	Is Action Likely To Jeopardize the Species?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Northern California steelhead (*Oncorhynchus mykiss*)	Threatened	Yes	No	No
California coastal Chinook (*O. tshawytscha*)	Threatened	Yes	No	No
SONCC Coho (*O. kisutch)*	Threatened	Yes	No	No

Fishery Management Plan That Describes EFH in the Project Area	Do Actions Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	No

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

Issued By: [signature], for
William W. Stelle, Jr.
Regional Administrator

Date: AUG 27 2015

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1 Introduction

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

1.1 Background

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

This batched biological opinion (Opinion) addresses an 11-year Letter of Permission procedure (LOP 2015) for instream gravel mining in Humboldt County, California, proposed by the United States Army Corps of Engineers (Corps), and an 11-year (2015-2025) individual permit application received by the Corps from the Hoopa Valley Tribe (HVT) for gravel mining and associated activities on the Hoopa Valley Indian Reservation (HVIR) on the Trinity River. This Opinion considers both the LOP 2015 and the individual permit application from the HVT and is a "batched" consultation [50 CFR § 402.14 (c)].

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available through NMFS' Public Consultation Tracking System [https://pcts.nmfs.noaa.gov/]. A complete record of this consultation is on file at the NMFS Northern California Coast Office, Arcata, California.

1.2 Consultation History

On April 6, 2015, NMFS received a letter from the Corps requesting formal consultation for gravel extraction activities permitted under LOP 2015 pursuant to section 7(a)(2) of the Endangered Species Act (ESA), as amended (16 U.S.C. 1531 *et seq.*) and its implementing regulations (50 CFR § 402). This request for consultation is for the issuance of the LOP 2015 procedure, and issuance of annual Letter of Modifications for LOP 2015 under the Clean Water Act (CWA) section 404, and the Rivers and Harbors Act (R&HA), section 10, for annual authorization of gravel extraction and associated activities from the Eel, Van Duzen, South Fork Eel, Trinity, Mattole, and Bear rivers, all in Humboldt County, California, for 10 calendar years beginning in 2015 and expiring on December 31, 2025. The Corps request also included a request for an individual permit to the HVT under the CWA section 404, for the extraction of gravel and associated activities on the HVIR on the Trinity River, Humboldt County, California, for 11 calendar years beginning in 2015, and expiring on December 31, 2025.

Preceding the request for consultation NMFS received final biological assessments (BA) the "Biological Assessment for Aggregate Extraction Operations in the Eel, South Fork Eel, Van Duzen, and Trinity Rivers, Humboldt County, California," dated February 2015, prepared by Stillwater Sciences; the "2015 Biological Assessment of Gravel Bar Mining, Middle Reach of the Eel River, Humboldt County, California," prepared by Humboldt Redwood Company; the "Biological

Assessment for ACOE LOP-2015, (Rev – A), Specific to Humboldt County Department of Public Works Instream Gravel Mining Operations, Humboldt County, California," dated Feruary 23, 2015, prepared by Humboldt County Public Works Natural Resources Division; and the "Biological Assessment, Hoopa Valley Tribe, Roads, and Aggregate," dated March 15, prepared by Trinity Valley Consulting Engineers, Inc. The request for consultation concerns the effects of the proposed gravel extraction and associated activities on threatened Southern Oregon/Northern California Coast (SONCC) coho salmon (*Oncorhynchus kisutch*), California Coastal (CC) Chinook salmon (*O. tshawytscha*) and Northern California (NC) steelhead (*O. mykiss*) and their designated critical habitats. On August 5, 2015, both the Corps and Eureka Ready Mix (applicant) clarified that theVan Duzen River migration egress culverts would no longer be part of the proposed action based on evidence gathered by NMFS during the consultation.

1.3 Proposed Action

1.3.1 LOP 2015

1.3.1.1.1 *LOP Procedure*

The following description of the LOP 2015-1 procedure is summarized from the Corps' Public Notice (PN), dated March 3, 2015, that describes the LOP 2015-1 in detail. Activities that may be authorized under the LOP 2015-1 include, but are not limited to, sand and gravel mining and work associated with these activities, such as temporary stock piling of gravel in a dry section of the stream, associated salmonid habitat improvement activities, and construction of temporary stream crossings. In order for the Corps to permit gravel mining under LOP 2015-1, gravel operators must: (1) follow the annual pre-extraction review and recommendation process; (2) use gravel mining methods that are included in the LOP; (3) implement the required terms or minimization measures; and (4) perform the monitoring specified in Appendix C and D of LOP 2015-1 (see Enclosure 1).

1.3.1.1.2 *Evaluation*

Gravel operators will submit complete permit applications, after conferring with the County of Humboldt Extraction Review Team (CHERT), to the Corps for review to determine whether the proposed excavation activity qualifies under LOP 2015-1. CHERT will help identify areas of concern and locations for cross-section monitoring. If the activity qualifies under LOP 2015-1, the operator will be granted an LOP for the duration of the procedure, pending annual confirmations by LOP modification letters. Each operator must also submit yearly monitoring data regarding extraction amounts, cross-sectional information, biological monitoring, and aerial photos as described in Appendix C (Enclosure 1). In general, projects that remove more than 250,000 cubic yards per year will not be considered eligible for authorization under the LOP 2015-1.

Each spring, the Corps will invite the U.S. Environmental Protection Agency (EPA), NMFS, U.S. Fish and Wildlife Service (USFWS), California Coastal Commission (CCC), California Department of Fish and Game (CDFG), and the California Regional Water Quality Control Board (RWQCB) to an interagency evaluation and coordination meeting to review new applications and yearly compliance data of previously authorized activities.

Should an agency, or member of the public, object to continuing an activity under an existing authorization, based on evidence of non-compliance or evidence of more than minimal impacts, the

Corps may suspend or revoke the existing authorization and require an individual permit unless the operator can demonstrate compliance with the LOP. The operator may also be required to reduce the future impacts of its operations to minimal impacts and mitigate for past non-compliance. The Corps will determine what constitutes a minimal impact.

Work may not proceed until the Corps' District Engineer has issued an LOP authorization letter. For projects which have obtained the LOP, the activity may not begin each year until a confirmation letter (Letter of Modification, or MOD) has been issued by the Corps. The Corps is responsible for determining compliance with the LOP 2015-1. The Corps may take action to rectify non-compliance. These actions may include, but are not limited to:

- Permit revocation;
- Permit suspension;
- Project site and habitat restoration; and
- Reduction of authorized gravel extraction.

1.3.1.1.3 ***Application Procedure***

Any new gravel mining project must submit a notice of intent to mine gravel to the Corps, Eureka Field Office, by February 1 of that year in order for the Corps to consider authorization under the LOP 2015-1. This Opinion considers the existing gravel mining sites that are listed in Table 1. There is not sufficient information to consider gravel mining sites that are not currently identified, nor are new mining sites reasonably certain to occur, thus new mining sites will not be considered further in this Opinion.

Before mining, a mutually agreeable date will be scheduled between CHERT, California Department of Wildlife (CDFW), the Corps and NMFS for pre-extraction site reviews, or a five working day notice of when the site review is scheduled to occur will be provided to NMFS. Following the site visits, a pre-extraction report (mining proposal) must be submitted to the Corps that contains the proposed extraction for the season as well as all information required in Appendix C (Enclosure 1). Following completion of extraction, a post-extraction report must be submitted as described in Appendix C (see Enclosure 1). Copies of all pre- and post-extraction information, including cross sections, aerial photos, and other information will be provided to the Corps, NMFS, CDFW, and CHERT.

In all cases, an application for authorization of work under LOP 2015 must include a written description of the project, proposed work schedule, the address and telephone number of a point of contact who can be reached during working hours, an 8.5 by 11 inch vicinity map, and an 8.5 by 11 inch site or location map showing the boundaries of all proposed work (maps and figures can also be on 11 by 17 inch paper) as well as all of the requirements in Appendix C (Enclosure 1). The information may be submitted on an Application for Department of the Army Permit form (ENG Form 4345) or in any other form which will clearly supply the information in a concise manner. Projects will also be considered in relation to other extraction operations.

General Timeline

FEB 1	CHERT annual report that evaluates the past extractions.
SPRING	Gravel Week: the involved agencies are invited to meet to review permit applications and compliance. No specific date is established for the annual meeting. Aerial orthographic photos to be taken. Gravel extraction plans along with CHERT recommendations submitted to the Corps and NMFS at the earliest possible date and reviewed by the Corps in the order received.
JUN 1	Earliest extraction.
JUN 30	Earliest construction of temporary channel crossings.
OCT 1	Gravel stockpiled on river bars must be removed on a daily basis after October 1. Each day thereafter, extraction sites will be groomed and graded to drain freely at the end of each working day. Channel crossings must be removed.
OCT 15	Grading must be completed. All gravel extraction ceases on river bars, unless an approved river flow monitoring plan is enacted and a time extension granted by the Corps.
NOV 1-	Revegetate mitigation areas. Post-extraction aerial photos are delivered to the Corps, CHERT, and NMFS.
DEC 15	Post-extraction cross section data and biological monitoring data submitted to Corps, NMFS and CHERT, except biological monitoring data gathered in November and December.
JAN 15	Mitigation monitoring reports due to Corps, NMFS, CDFW, and CHERT.
FEB 28	Biological monitoring data gathered in November or December submitted to the Corps, NMFS, CDFW, and CHERT.

1.3.1.2 Gravel Extraction Methods

Traditional Skim
Skimming of gravel from exposed gravel bars involves the use of excavating machinery to remove the uppermost layer of gravel. Skimming will be performed above the 35 percent exceedence flow water surface elevation of the low flow channel, and downstream from the head-of-bar buffer (described below), and on exposed (dry) bars, within the active channel that is typically inundated annually. After skimming, the bar must be graded in order to be left smooth, free of depressions and with a slope downstream and/or to the low-flow channel. Traditional skims are typically laid out as

curvilinear benches along the outside of gravel bars, and are typically no wider than about half the exposed bar surface width.

Horseshoe Skim

This method removes gravel from the downstream two-thirds of gravel bars. A lateral edge-of-water buffer is maintained along the low flow channel. The upper third of the bar will be left in an undisturbed state as the head-of-bar buffer (described below). The finished grade of the extraction area will have a downstream gradient equal to the river gradient and a flat cross slope and will be no lower than the 35 percent exceedence flow elevation. Cut-slopes will be left at a 2:1 (horizontal:vertical) slope, except along the upstream side at the head-of-bar buffer where a 6:1 slope will be established. There will be at least a 15-foot offset buffer from the bank. The extraction surface will daylight along the downstream one-third to one-fifth of the bar to facilitate drainage following high runoff events.

Inboard Skim

This method is similar to the horseshoe skim except that it maintains a wider horizontal offset from the low flow channel where warranted. These areas will be excavated to a depth no lower than the water surface elevation of the 35 percent exceedence flow, with a 0–0.5 percent cross slope, steeper (1:1) slopes on the sides, and gentle (10:1) slopes at the head of the excavation. There will be a 15-foot offset buffer from the bank. The excavation may extend into the upper one-third of the head-of-bar buffer if sufficient rationale is provided to show that protection of the upstream riffle will be maintained.

Narrow Skim

Narrow skims will be no more than one-third of the bar width, follow the shape of the bar feature, maintain the point of maximum height of the bar, and trend in the general direction of streamflow. These skims will maintain a vertical offset corresponding to the discharge at 35 percent exceedence level. Finished narrow skims will be free draining and slope either toward the low-flow channel or in a downstream direction. Furthermore, these skims will avoid the head-of-bar buffer. This buffer may be decreased on a case-by-case basis provided the extraction area narrows, tapering smoothly to a point and remains below the upstream cross-over riffle.

Narrow Skim - Van Duzen River

Narrow skims along the Van Duzen River will be limited to a maximum width of 90 feet across the top of the extraction. This width is designed to contain average peak flows of 1,000 cfs commonly seen during the early period of adult salmonid migration in November and December. The minimum skim floor will be equal to the water surface elevation of the 35 percent exceedence flow.

Narrow Skim - Lower Eel River

Narrow skims that are adjacent to the low flow channel, but are not adjacent to entire riffle areas, will be considered for the lower Eel River. These narrow skims will have a minimum vertical offset equal to the water surface elevation of the 35 percent exceedence flow. Narrow skim widths will be determined on a site specific basis, and will: (1) not increase channel braiding; (2) not lower the elevation at which flows enter secondary channels; (3) avoid the higher elevation portions of the annually inundated bar surface; and (4) maintain channel confinement.

Secondary Channel Skim
These extractions are elongate, shallow skims in the area of dry, secondary channels, designed to be free-draining and open at either end so as to not impede fish passage and to prevent any potential fish stranding. The upstream riffle crest, or elevation control of secondary channels will not be affected by extraction proposals. The skim floor of these excavations will be set at the 35 percent exceedence flow elevation.

Alcoves
Alcove extractions are located on the downstream end of gravel bars, where naturally occurring alcoves form and may provide velocity refuge for juvenile salmonids during high flows, and potential thermal refuge for juvenile salmonids during the summer season. Alcove extractions are irregularly shaped to avoid disturbance of riparian vegetation, and are open to the low flow channel on the downstream end to avoid stranding salmonids. Alcoves are extracted to a depth either above or below the water table.

Wetland pits
Wetland pits are irregularly shaped excavations (to avoid excavating riparian vegetation) located on the 2-to-5 year floodplain surface. An excavator digs out the sediment below the water table and leaves the sides of the pit sloped. Wetland pits must have vegetation, either existing or planted, around their perimeter and must contain some type of cover elements, such as woody debris.

Wet trenching
Wet trenching excavates sediment directly from dry portions of the channel near the wetted perimeter. The wet trench extends below the water table and may be excavated adjacent to the flowing channel. The upstream and downstream ends of the trench would be opened to the river's flow once the suspended sediment has settled out. Wet trenches are typically constructed adjacent to the wetted channel. The wet trenching method would only be used when there is the additional objective of improving instream salmonid habitat or reducing effects on the channel's width and depth.

Dry trenching
The dry trenching method of extraction may be both shallow and stay above the water table or deep and extend below the water table, and removes gravel from the exposed (dry) bar surface. A gravel berm may be constructed with materials on site to isolate the trench from the channel. After excavation, and when the sediment in the trench has settled, the berm is breached on the downstream end, and the trench is connected to the river to prevent fish stranding. Alternatively, the berm may be constructed to be naturally breached during normal fall flows.

Modifications
Modifications to extraction limitations, when they provide equal or greater protection to listed fish species, may be approved by the Corps.

1.3.1.3 Minimization Measures/Gravel Extraction Terms

Projects authorized under LOP 2015-1 are subject to the following terms that minimize the effects of gravel mining on river morphology and listed salmonids. The Corps has the right to add or modify terms or measures as appropriate. Modifications to excavation procedures may be made to increase fisheries and wildlife habitat with Corps approval.

1.3.1.3.1 ***CHERT Process for Annual Review and Recommendation***

The annual CHERT review and recommendation for each proposed gravel extraction site is a requirement of the LOP 2015-1. Gravel miners contact CHERT at the beginning of each extraction season to discuss opportunities for extraction at their site. CHERT or the miner schedules a pre-extraction site review, and involved agencies are invited to attend and provide input. Extraction alternatives are discussed on site, and CHERT prepares a written recommendation for extraction prior to the Corps' issuance of the annual Letter of Modification. As part of their extraction recommendation, CHERT provides a summary of its rationale and describes how the proposed extraction does not significantly increase the risk of channel braiding, how the extraction attempts to promote channel confinement, and does not increase the risk of adult salmonid stranding or increase the risk of riffle instability. More detail about CHERT is provided by Humboldt County on their website: http://www.humboldtgov.org/252/Surface-Mining-Reclamation-Act-SMARA-Doc.

1.3.1.3.2 ***Minimum One-Third Head-of-Bar Buffer***

The upstream end of the bar (head-of-bar) will not be mined or otherwise altered by activities authorized by the LOP 2015-1. The minimum head-of-bar is defined as that portion of the bar that extends from at least the upper third of the bar to the upstream end of the bar that is exposed at summer low flow. Therefore, the upstream one-third portion of the bar as exposed at summer low flow is provided as the minimum head of bar buffer. The intent is to protect the natural stream flow steering effect provided by an un-mined bar.

Some alternative extraction techniques, such as longer and much narrower skims adjacent to the low flow channel, have specific geomorphic objectives that may require extraction on a portion of the head-of-bar buffer. Variances to the minimum head of bar buffer may be considered on a case-by-case basis, if the proposed alternative provides equal or greater protection. The specific nature of the proposed variance must be described, along with sufficient biological, hydrological, and sediment transport rationale to support the recommended alternative. For example, any modification in the default head-of-bar buffer dimensions should, at a minimum, provide for protection of the adjacent cross-over riffle, by limiting extraction to the area downstream of the riffle.

1.3.1.3.3 ***Minimum Skim Floor Elevation***

The minimum skim floor elevation will be defined as the elevation of the water surface at the 35 percent exceedence flow for each site, on an annual basis. Instructions for determining, marking and reporting the water surface elevation of the 35 percent exceedence flow are available from Corps. Additionally, the water surface elevation of the 35 percent exceedence flow will be marked on the gravel bar and indicated on the cross section survey data.

1.3.1.3.4 ***Pollution Prevention and Minimization***

Equipment will be parked above the OHWM during maintenance, fueling, and after-hours. The site will be inspected daily for grease, oil, or other fluid spills. If a spill is observed, photograph and document the spill and implement the spill-cleanup plan and notify the Corps' and NMFS' points of contact. All tires and auto body debris, or other large metal debris will be removed from the gravel bar and disposed/recycled properly.

1.3.1.3.5 *Temporary Channel Crossings*

Design and Construction

The location, construction and removal of all temporary channel crossings will be reviewed by the Corps, NMFS, CDFW, and CHERT for conformance with these guidelines and will be described in the CHERT recommendation. Crossings will be designed and installed to minimize turbidity and geomorphic impacts from bridge construction, bridge use and bridge removal. Factors that will be considered include habitat quality, channel width, length of available bridges, required bridge width, water depth and velocity, amount of fine sediment in the native gravel and the availability of washed rock.

- Main channels must be spanned to the maximum length practicable using either a flatcar or bridge span. Culverts may be approved for use in secondary channels on a case-by-case basis.

- Heavy equipment passes across the wetted channel during temporary channel crossing construction and removal will be kept to an absolute minimum and described in the CHERT recommendation. Heavy equipment passes will be limited to two passes per bridge construction and two passes per removal.

- Native gravel can be used for bridge approaches and abutments if the bridge will completely span the wetted channel, and the abutment materials are removed and graded onto approved sites upon bridge removal.

- Use of brow logs, concrete blocks, concrete K-rails or other suitable materials will be used in temporary abutments to minimize the amount of sediment required for abutments or approach ramps.

- If encroachment into the low flow channel is necessary to span the wetted channel, then approach ramps will be constructed using techniques to reduce delivery of fine sediment to the channel. These techniques could include a base of washed rock or cobbles on the access side of the stream. The base will extend from the bed of the stream to six inches above the water surface at construction time. This base can be topped with native gravel. Alternatively, if washed rock is not readily available, native gravel used in wetted approaches and abutments may be lined with filter fabric and surrounded with K-rails. Other methods that will provide equal or superior protection from turbidity impacts may be suggested by the operator and presented for review and recommendation by CDFW, CHERT, and NMFS. Other methods may be approved if they meet the objective of minimizing sediment delivery to the wetted channel.

- Upon bridge removal, the original channel configuration will be restored to the fullest extent feasible.

Timing
Temporary crossings will be constructed after June 30 only. All crossings and associated fill must be removed by October 1. The Corps will coordinate with NMFS on requests for time extensions for bridge construction or removal, due to the sensitivity of working directly within the wetted channel.

Location
Bridge locations will avoid known spawning areas. The middle of riffles may provide the best location for temporary crossings since the bridge may be able to span the entire wetted channel. Where bridges are not able to span the entire wetted channel, the crossing location will be determined on a site-specific basis. The proposed location, and rationale used to determine how the crossing location minimizes effects to salmonids, will be included in the CHERT recommendation. Haul roads will follow the shortest route possible while avoiding sensitive areas such as riparian vegetation. If excessive compaction is identified, the roads will be scarified after extraction is complete.

1.3.1.3.6 ***Reach Specific Minimization Measures***

Lower Eel River
Alternative extraction techniques will be preferred over traditional skimming. These alternative techniques may include, but are not limited to alcoves, wetland pits, trenches, and dry-trenches, as described previously in this *Description of the Proposed Action* section. In addition to the alternative extraction techniques, narrow skims that are designed according to the lower Eel River specifications may be used.

South Fork Eel River
Alternative extraction techniques will be given deference over traditional skimming. These alternative techniques may include, but are not limited to alcoves, wetland pits, trenches, and dry-trenches, as described previously in this *Description of the Proposed Action* section.

Van Duzen River
Extraction proposals in the Van Duzen River will be limited to alternative extraction designs, such as trenching, alcoves, horseshoe pits, very narrow skims, *etc*. In particular, trenching is recommended in some locations in the lower Van Duzen River, especially when very close to the wetted channel. Very narrow skims on the Van Duzen River will be limited to 90 feet total width, as measured across the top of the extraction. Extraction proposals will include rationale describing how the proposal will prevent increases in the width-to-depth (W/D) ratio and not increase the likelihood of salmon stranding.

Trinity River
The minimum skim floor elevation on the Trinity River will be a minimum of two feet above the adjacent summer low-flow water surface elevation.

1.3.1.4 Storage and Stockpiles

Temporary storage of excavated material may occur on the gravel bar, but must be removed by October 1. In order to minimize the turbidity associated with excavating wet sediment, all wet excavated sediment must be stockpiled on the gravel bar away from the low flow channel and allowed to drain prior to hauling across any temporary channel crossing.

1.3.1.5 Vegetation and Wetlands

All riparian woody vegetation and wetlands will be avoided to the maximum extent practicable. Any riparian vegetation or wetland that is to be disturbed will be clearly identified on a map. Woody vegetation that is part of a contiguous 1/8-acre complex or is at least 2 inches diameter that is disturbed will be mitigated. Impacts to other woody vegetation will be described and submitted to the Corps and CHERT with the gravel extraction plans. These impacts may require mitigation at the discretion of the Corps. Areas that will be mapped consist of riparian vegetation that have driplines within 25 feet of excavation activities (excavation, stockpiling, parking, *etc.*) or wetlands, which are filled, excavated or drained. Mitigation for impacts to woody vegetation will not be required for pre-existing haul roads, stockpile areas and facilities.

1.3.1.6 Structure Setbacks

Gravel removal will remain a minimum distance of 500 feet from any structure (bridge, water intake, dam, *etc.*) in the river. For bridges, the minimum setback distance is the length of the bridge or 500 feet, whichever is greater. Gravel removal may encroach within this setback if written approval is given by owners of these structures and approved by the Corps.

1.3.1.7 Regrading

The mined, or disturbed, area must be graded, if necessary, before the water levels rise in the rainy season. Grading must be completed by October 15 each year. Grading includes filling in depressions, grading the construction/excavation site according to the approved configuration, leaving the area in a free-draining configuration (no depressions and sloping toward the low flow channel).

1.3.1.8 Timing of Extraction

Unless the operator's LOP is specifically modified, gravel extraction will cease by October 15 each year. Grading, if necessary, will be completed prior to October 15 each year. Requests for a time extension will be reviewed on a case-by-case basis. The operator, however, must have graded the site before an extension can be authorized. The Corps will coordinate with CHERT, CDFW, and NMFS before a decision is made on the time extension.

1.3.1.9 Habitat Enhancement and Protection

1.3.1.9.1 ***Habitat Improvement Activities***

The actions authorized by the LOP 2015 can include certain activities at gravel extraction sites, during extraction seasons, that will enhance habitat for salmonids and other riverine species. The specific details of such habitat enhancement activities will be determined during the pre-extraction review and recommendation process. Habitat enhancement activities may include, but are not limited to, trenching designed to improve salmon migration, alcove construction, placement of edge water large woody debris, riparian planting and strategic placement of large wood and boulders in the stream. Some specific habitat improvement activities have been identified in the BAs for the LOP 2015 (Stillwater Sciences 2015; HCPW 2015; HRC 2015), and include, trenching to improve salmonid migratory habitat in the Van Duzen River and riparian planting to improve rearing habitat in the Van Duzen River.

Certain habitat enhancement activities, such as riparian planting projects, may be conducted outside of the normal extraction operating season. For example, riparian planting efforts tend to have a higher rate of success when cuttings are collected and planted during the fall and winter.

1.3.1.9.2 ***Protection of Large Woody Debris***

Large woody debris (LWD) in the wetted channel and on floodplains is an important component of aquatic and riparian habitat. However, it is common practice for LWD to be gathered by local residents for firewood and other uses. To reduce the adverse effects of this longstanding practice, educational signing regarding the importance of LWD for salmonids will be placed at access roads owned, controlled, or utilized by the gravel operators. In addition, in order to protect LWD deposited on mined gravel bars, all access roads owned or controlled by commercial gravel operators will be gated and locked to reduce access.

1.3.1.10 Proposed Mitigation

The Corps requires each gravel operator to mitigate impacts to wetlands and riparian zones in the following manner: avoiding, minimizing, rectifying, reducing or eliminating the impact over time, and finally, compensating for impacts. For all unavoidable impacts, a mitigation plan will be submitted with applications for all projects that will adversely affect wetlands and riparian vegetation. Mitigation will consider the size and age of the vegetation removed or adversely impacted. All vegetative mitigation will be planted between November 1 and February 28 of the year following excavation and will have a survival rate determined by the Corps on a site-specific basis, over three growing seasons. Failure to obtain a Corps specified three-year survival rate will require replanting. Annual reports depicting the survival of vegetation will be due by December 31 each year for three growing seasons after planting year.

1.3.1.11 Site Visits

Site visits will be conducted by the Corps, CDFW, NMFS, and CHERT before and after gravel extraction operations at all locations. Additional site visits can be made upon request by the operator or when otherwise deemed necessary by the Corps, NMFS, CHERT, CDWF, or other participating agencies. Pre-extraction visits will be done as part of the review and Corps approval process. Post-extraction visits will be as soon as possible following completion of operations and prior to site inundation by rising river stages in the fall. To help ensure this occurs in a timely manner, gravel operators will notify the Corps, NMFS, CDFW, and CHERT by email, phone, or fax within two business days of project completion. The Corps will provide an operational checklist (please see the draft form at Appendix N of the LOP 2015) to the operator outlining the habitat improvement goals for the specific river reach, and the procedures that occur during the extraction season.

1.3.1.12 Monitoring

Monitoring required by the LOP 2015 includes: 1) monitoring cross sections for all rivers; 2) water surface elevation at the 35 percent exceedence flow for all rivers, except the Trinity River where minimum 2 foot vertical offset is used for skims, rather than the 35 percent exceedence flow elevation, and 3) habitat mapping and biological observations for all rivers. These data are described in Appendix C and D (Enclosure 1) and will be collected on an annual basis and reported to the Corps, NMFS, CDFW, and CHERT, unless otherwise noted.

1.3.1.13 LOP 2015 Operators

The Corps proposes to permit the following operators in the following watersheds under the LOP 2015 procedure (**Table 1-1**). Specific bar locations are described by Stillwater Sciences (2015), HCPW (2015) and HRC (2015).

Table 1-1. Annual maximum gravel extraction by bar, operator and watershed.

Watershed	Operator	Bar	Annual Maximum Extraction as defined by Humboldt County permit
Lower Eel River	Eureka Sand & Gravel	Hauck Bar (River Mile [RM] 14.0)	150,000 cubic yards (cy)/yr
		Singley Bar (RM 6.0)	150,000 cy/yr
	Mercer-Fraser Company	Sandy Prairie Bar complex (RM 10.5)	270,000 cy/yr (70,000 cy/yr for Pedrazzini site and 200,000 cy/yr for Canevari site)
	Mallard Pond	Drake Bar (RM 8.0)	250,000 cy/yr
	Humboldt County	Worswick Bar (RM 7.0)	25,000 cy/yr
Van Duzen River	Humboldt County	Pacific Lumber Bar (RM 16.7)	3,000 cy/yr
	Thomas R. Bess Asphalt Sand & Gravel	Bess Bar (RM 5.4)	20,000 cy/yr
	Rock and Gadberry Sand and Gravel	Leland Rock Bar (RM 0.3)	100,000 cy/yr
	Jack and Mary Noble	Van Duzen River Ranch Bar (RM 3.3)	100,000 cy/yr
South Fork Eel River	Randall Sand and Gravel	Randall Bar complex (RM 34)	50,000 cy/yr, but ≤40,000 cy annual average over 3 yr period

	Wallan and Johnson	Wallan Bar (RM 30)	12,500 cy/yr, but ≤10,000 cy annual average over 5 yr period
Middle-Main Eel River	Humboldt County and the Satterlees	Satterlee Bar (RM 68)	35,000 cy/yr for HC and 7,300 for Satterlees
	Humboldt Redwood Company	Maynard Bar (RM 45.4), Vroman Bar (RM 44.4), Bowlby Bar (RM 41.8), South Fork Bar (RM 40.6), Holmes Bar (RM 36.4), Elinor Bar (RM 27.6), Three Mile Bar (RM 24.7), Dinner Creek Bar (RM 23.7), Truck Shop Bar (RM 23.1), and Scotia Dam Bar (RM 22.2).	160,000 cy/yr for all bars combined, but not exceeding 30,000 cy/yr at each bar. Humboldt County jointly owns the South Fork Bar, and mines a portion of the maximum for that site.
Trinity River	Mercer-Fraser Company	McKnight Bar (RM 29)	10,000 cy/yr
	Mercer-Fraser Company	Big Rock Bar (RM 25)	40,000 cy/yr
	Klamath-Trinity Aggregates	Rowland Bar (RM 13)	20,000 cy/yr
North Fork Mattole River	Humboldt County	Cook Bar (RM 6.6 on Mattole River)	34,000 cy per 3-yr period
Bear River	Humboldt County	Branstetter Bar sites (RM 1.5)	3,000 cy /yr and 10,000 cy per 3-5 yr period

1.3.2 <u>Hoopa Valley Tribe</u>

The Corps proposes to issue an individual permit to the HVT for gravel extraction and associated activities on the seven gravel bars described below. The permit will cover an eleven year time period (2015-2025). The HVT will extract a cumulative total of up to 100,000 cubic yards of gravel annually on all or several of the seven bars. Annual gravel extraction will occur when the bars are exposed during low water periods between June 1 to October 15.

- Security East Bar (RM 12): the most downstream of the seven extraction sites located on the right or east bank of the Trinity River.

- Security West Bar (RM 12.75): located on the left or west bank of the Trinity River. This bar is located east of the Hoopa Fire Station and Highway 96.

- Cal-Pac Bar (RM 14.5): located on the west bank of the Trinity River. The Cal-Pac Bar is located east of Highway 96 and east of the gravel processing plant and administrative office of Hoopa Valley Aggregates & Readymix Enterprises.

- Tish Tang No. 8 Bar (RM 15): located on the right or east bank of the Trinity River just upstream of the Cal-Pac Bar. Tish Tang No. 8 Bar will likely require the use of a summer bridge crossing to reach this extraction area from the gravel processing plant on the west side.

- Campbell Bar (RM 15.5): located on the west bank of the Trinity River just upstream of Tish Tang No. 8.

- Tish Tang Creek Bar (RM 16.5): located on the mouth of Tish Tang Creek that drains into the right bank of the Trinity River across from Tish Tang Campground.

- Tish Tang Bar (RM 16.75) - the most upstream gravel extraction site, located on the left or west bank of the river adjacent to Tish Tang Campground.

1.3.2.1 Gravel Extraction Methods for Hoopa Valley Tribe

Horseshoe Skim
This method will harvest gravel from the downstream two-thirds of gravel bars. A lateral edge-of-water buffer is maintained along the low flow channel. The upper third of the bar will be left in an undisturbed state as an upper-bar buffer. The finished grade of the extraction area will have a downstream gradient equal to the river and a flat cross slope and will be no lower than one-foot above the low flow water surface elevation as identified during the pre-extraction review. Cut-slopes will be left at a 2:1 (horizontal:vertical) slope except along the upstream side at the head-of-bar buffer where a 6:1 slope will be established. There will be at least a 15-foot offset buffer from the bank. The extraction surface will daylight along the downstream one-third to one-fifth of the bar to facilitate drainage following high runoff events.

Inboard Skim
This method is similar to the horseshoe skim except that it maintains a wider horizontal offset from the low flow channel where warranted. These areas will be excavated to a depth no lower than the water surface elevation offset, with a 0–0.5 percent cross slope, steeper (1:1) slopes on the sides, and 10:1 slopes at the head of the excavation. There will be a 15-foot offset buffer from the bank.

Traditional Skim
A traditional skim is not more than half the bar width as measured at the widest point of the bar. This method does not extend beyond the upper one-third head-of-bar buffer and the skim floor will be set at a minimum of one-foot above the low flow water surface elevation.

Secondary Channel Skims
These extractions are elongate, shallow skims in the area of dry, secondary channels, designed to be free-draining and open at either end so as to not impede fish passage/migration and to prevent any potential fish stranding. The upstream riffle crest, or elevation control of secondary channels will not be affected by extraction proposals. The skim floor of these excavations will be set at a minimum of one-foot above the low flow water surface elevation.

Trench
A trench is generally a long, narrow excavation adjacent to, but outside of the wetted perimeter of the channel. Trenches will be connected to the wetted channel at the upstream and downstream ends (after sediment has settled out) to prevent entrapment of fish.

Wet Floodplain Pits
Wet floodplain pits are irregularly shaped (to avoid excavating riparian vegetation) excavations located on the floodplain surface. An excavator digs out the sediment below the water table and leaves the sides of the pit sloped. Wet pits are located on the one to two flood surfaces. Wet pits may have vegetation, either existing or planted, around their perimeter, and may contain some type of instream cover elements, such as woody debris. Lower elevation wet pits will have a connection to the low flow channel or other frequently inundated secondary channel to allow for seasonal salmonid use and reduce fish entrapment potential.

Oxbows
Narrow, linear, off-channel excavations along historic channel locations, typically defined on aerial photographs by curvilinear vegetation colonization, muted secondary channels, or as the toe of a moderate to high terrace or valley margin. Excavation will be located in the downstream half of the bar to minimize channel capture and could be excavated deeper than the adjacent thalweg. Oxbow extractions could have willow vegetation and LWD placed in them to enhance their cover habitat.

Alcoves
Alcove extractions are typically located on the downstream end of gravel bars, where naturally occurring alcoves form and may provide velocity refuge for juvenile salmonids during high flows, and potential thermal refuge for juvenile salmonids during the summer season. Alcove extractions are irregularly shaped to avoid disturbance of riparian vegetation, and are open to the low flow channel on the downstream end to avoid stranding salmonids. Alcoves are extracted to a depth either above or below the water table.

High Terrace Skim
This method extracts gravel from the 10-year or greater floodplain that is located at the downstream end of the gravel bar. The elevation of the extraction will be determined during the field visit, but will generally be designed to promote backwatering and fine sediment deposition at higher flows to foster riparian vegetation development by creating a suitable seed bed that is at a low enough elevation so seedling roots can gain access to summer groundwater. The extraction may be phased over a number of seasons to cover the planned area. However, once a surface has been extracted the subsequent riparian vegetation growth will preclude the site's use as an active extraction area in the future.

1.3.2.2 Impact Minimization Measures

1.3.2.2.1 ***Annual Extraction Planning***

The gravel extraction planning process is the primary minimization measure. Prior to each season's gravel operation, the HVT and Corps will meet at each proposed gravel extraction site to discuss how HVT can extract sufficient gravel for their needs at that particular site while at the same time addressing how to avoid or minimize adverse impacts to fish and wildlife and aquatic habitat. NMFS will also be invited to attend the site visit and provide input. The monitoring cross-sections, pre-extraction and post-extraction cross sections, and aerial photos are utilized to: (1) propose annual extraction volumes; (2) estimate the volume of replenished gravel; (3) identify changes in river alignment, as well as channel bed elevation trends; (4) track successional vegetation growth; (5) locate and design extraction complementary to the natural features of the river channel, and (6) track the conditions of previously extracted surfaces to better design future extractions.

1.3.2.2.2 ***Excavation Requirements***

Bar skimming will be conducted starting at an elevation one foot above the low water surface elevation and proceeding with a longitudinal slope equal to the river and/or cross bar slope. The minimum vertical offset of at least one vertical foot above the water surface elevation is typically applied at the time of cross-section surveys. Most of the gravel bars are devoid of vegetation due to annual scour, however, HVT will avoid removing established riparian vegetation. Excavated gravel will be stored off-site as gravel will be hauled directly to an upland processing plant. Gravel will be transported utilizing existing roads from extraction sites to the processing site. After site reviews with the Corps and NMFS, the HVT will prepare final proposed extraction plans for each site and submit such plans to the Corps and HVT Council for approval.

The final extraction surface will be free-draining to minimize the potential for fish stranding. Grade control will be set throughout extraction areas to enable achievement of accurate finish elevations as extraction proceeds. Final excavation surfaces will slope slightly in the downstream direction. The project area must be graded, if necessary, before the water levels rise in the rainy season, and must be completed by October 15 each year. Grading includes filling in depressions, grading the construction/excavation site according to the approved configuration and leaving the area in a free-draining configuration without depressions and sloping toward the low flow channel.

1.3.2.2.3 ***Monitoring***

River monitoring activities include evaluation and comparison of bi-annual aerial photographs coupled with on-the-ground surveying and comparison of recent and historic monumented full-channel cross sections which identify the hydrological and morphological alterations.

The HVT will conduct monitoring that includes: (1) pre-extraction cross sections; (2) post-extraction cross sections; (3) monitoring cross sections, and (4) high water elevation and location from the previous winter.

1.3.2.2.4 ***Temporary Channel Crossings***

Temporary channel crossings will consist of a flatcar or bridge span at the maximum length possible. The channel crossing will be placed at a riffle at the upstream end of the bar. A minimum distance of six feet above the water surface will be maintained as long as the bridge is in place. Due to the potential for boating traffic, the HVT may increase the vertical distance by a foot or more. A loader will be required to drive across the main channel at the bridge location in order to construct temporary gravel abutments at each end of the bridge. Each end of the flatcar bridge could be placed on brow logs at the edge of the main channel. The brow logs (or concrete blocks, *etc*.) will help to maintain the desired vertical clearance beneath the bridge.

The location and construction of all temporary channel crossings will be reviewed during the pre-extraction review process. Channel crossings will be designed and installed to minimize turbidity and geomorphic impacts from construction, use and removal. Factors that will be considered include: habitat quality, channel width, length of available bridges, required bridge width, water depth and velocity, amount of fine sediment in the native gravel, and availability of washed rock.

- Channels must be spanned to the maximum length practicable using either a flatcar or bridge span. Culverts may be approved for use in secondary channels on a case-by-case basis.

- Heavy equipment passes across the wetted channel during temporary channel crossing construction and removal will be kept to an absolute minimum. Heavy equipment passes will be limited to two passes per bridge construction and two passes per removal.

- Native gravel can be used for bridge approaches and abutments if the bridge will completely span the wetted channel, and the abutment materials are removed and regraded onto approved sites upon bridge removal. Abutments will be isolated from the channel by blocks, k-rails, or other suitable materials to reduce turbidity.

- Use of brow logs, concrete blocks, concrete K-rails or other suitable materials will be used in temporary abutments to minimize the amount of sediment required for abutments or approach ramps.

- If encroachment into the low flow channel is necessary to span the wetted channel, then approach ramps will be constructed using techniques to reduce fine sediment delivery to the channel. These techniques could include a base of washed rock or cobbles on the access side of the stream. The base will extend from the bed of the stream to six inches above the water surface at construction time. This base can be topped with native gravel. Alternatively, if washed rock is not readily available, native gravel used in wetted approaches and abutments may be lined with filter fabric and surrounded with K-rails. Other methods that will provide equal or superior protection from turbidity impacts may be suggested by the HVT and presented for review and Corps approval. Other methods may be approved if they meet the objective of minimizing sediment delivery to the wetted channel.

- Upon bridge removal, the original channel configuration will be restored to the fullest extent feasible.

Temporary crossings will be placed after June 30. All crossings and associated fills will be removed after excavation ceases, but before October 1. The Corps will provide NMFS a copy of any request for a time extension for bridge construction or removal for its review before the time extension may be authorized by the Corps, due to the sensitivity of working directly within the wetted channel. Requests for a time extension will be reviewed on a case-by-case basis.

To minimize the potential for adverse impacts to adult salmonids the HVT will agree to the following conditions and will coordinate closely with regulatory agencies on the following:

- The HVT will monitor the National Weather Service (NWS) Eureka website on a daily basis after October 15. The purpose of the monitoring will be to determine if a weather system is approaching the area that has the potential to deliver at least one inch of rainfall. If the NWS predicts one inch of rain then the bridge will be removed immediately. In addition, the HVT must consider the potential for flow increases in the Trinity River that may occur for a number of reasons including, but not limited to flows for improving conditions for salmonids in the Klamath and Trinity rivers and for cultural reasons.

- The HVT will inspect the bridge site on a daily basis to determine if adult salmonids are attracted to the site by the change in water depth, velocity, overhead cover, etc. The bridge will be immediately removed if adult salmonids are observed at the site.

- The HVT will ensure the extraction site is in a post-extraction groomed condition at the end of each day following October 15. This will allow for immediate removal of the bridge, if necessary, and preclude the necessity of waiting for reclamation activities to be completed.

Temporary channel crossing locations will avoid known spawning areas. The middle of riffles may provide the best location for temporary channel crossings since the crossing may be able to span the entire wetted channel. Where crossings are not able to span the entire wetted channel, the crossing location will be determined on a site-specific basis. Haul roads will follow the shortest route possible while avoiding sensitive areas such as riparian vegetation. If excessive compaction is identified, the roads will be scarified after extraction is complete.

1.4 Action Area

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

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 includes the LOP 2015-1 and HVT gravel mining sites (Figure 2-1). Specifically, the action area encompasses the lower Eel River from the mouth of the Van Duzen River to below Fernbridge, the Eel River from the mouth of the South Fork Eel River to near the town of Scotia, the South Fork Eel River from the Humboldt and Mendocino County line to near the town of Redway, the lower Van Duzen River (a major tributary to the Eel River) from about RM 17 to its confluence with the Eel River, the lower Trinity River near the towns of Salyer, Willow Creek and Hoopa, and one site each on the North Fork Mattole River at its confluence with the Mattole River, on the Bear River near the town of Ferndale, and at one site on the upper Eel River near Fort Seward (RM 68).

The commercially mined river sections that have ongoing operations are in generally unconfined, alluvial reaches that allow for gravel deposition. The lateral extent of the action area for the LOP 2015 and HVT includes the river channel, the floodplain and the contemporary river meander belt. The action area also includes tributary mouths that enter the mined river reaches and downstream habitat that may be affected by gravel mining and associated activities. The action area is more specifically defined by watershed in the Environmental Baseline section of this Opinion.

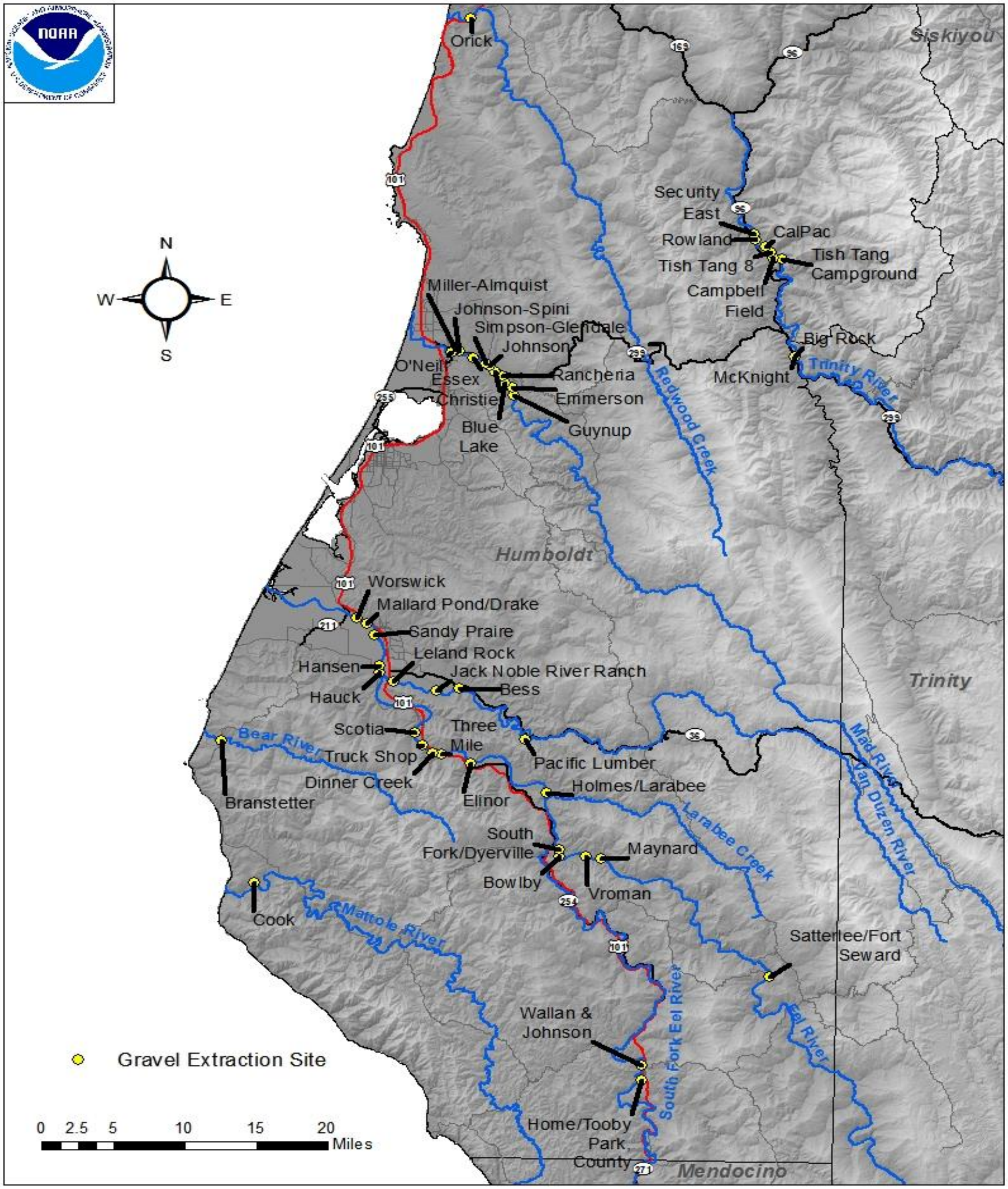

Figure 2-1. Proposed gravel mining sites in Humboldt County (Note: sites within the Mad River are not included in LOP 2015-1).

2 Endangered Species Act: Biological Opinion and Incidental Take Statement

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

2.1 Analytical Approach

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

The adverse modification analysis considers the impacts of the Federal action on the conservation value of designated critical habitat. This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 CFR 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.[1]

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

- Identify the rangewide status of the species and critical habitat likely to be adversely affected by the proposed action.
- Describe the environmental baseline in the action area.
- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.
- Describe any cumulative effects in the action area.
- Integrate and synthesize the above factors to assess the risk that the proposed action poses to species and critical habitat.

[1] Memorandum from William T. Hogarth to Regional Administrators, Office of Protected Resources, NMFS (Application of the "Destruction or Adverse Modification" Standard Under Section 7(a)(2) of the Endangered Species Act) (November 7, 2005).

- Reach jeopardy and adverse modification conclusions.
- If necessary, define a reasonable and prudent alternative to the proposed action.

Predicting the effects on a population and a species requires an understanding of the condition of the population and species in terms of their chances of surviving and recovering. To do this, the probability of recovery is determined, given their condition and threat regime during the period of impact. Viability is the state in which extinction risk of a population is negligible over 100 years and full evolutionary potential is retained (McElhany *et al.* 2000). A viable population (or species) is one that has achieved the demographic parameters needed to be at low risk of extinction. The risk of extinction of the species is equated with the "likelihood of both the survival and recovery of the species in the wild" for purposes of conducting jeopardy analyses under section 7(a)(2) of the ESA. The jeopardy analysis, therefore, focuses on whether a proposed action appreciably increases extinction risk, which is a surrogate for appreciable reductions in the likelihood of survival and recovery.

The expected response of salmonid populations is determined by assessing any potential reductions in the numbers, reproduction, distribution or diversity of listed salmonid populations in the action area. We then determine whether any will appreciably reduce the likelihood of both the survival and recovery of the affected listed salmonid populations. Finally, NMFS considers the status and trends of the ESU or DPS, the factors currently and cumulatively affecting them, and the role the affected population likely plays in the ESU or DPS to determine if reductions in the populations' likelihood of survival and recovery would be expected to reduce the likelihood of survival and recovery of the species at the ESU or DPS level.

NMFS has adopted the general life cycle approach outlined by McElhany *et al.* (2000), and the concept of Viable Salmonid Populations (VSP) as an organizing framework in consultations. In this Opinion, the concept of VSP is used to systematically examine the complex linkages between project effects and viability. The four VSP parameters (abundance, population growth rate (productivity), population spatial structure, and population diversity) reflect general biological and ecological processes that are critical to the growth and survival, and are used to evaluate the risk of extinction (McElhany *et al.* 2000). These parameters are used as surrogates for the "reproduction, numbers, or distribution" criteria found within the regulatory definition of jeopardy (50 CFR § 402.02). The fourth VSP parameter, diversity, relates to all three criteria.

2.2 Rangewide Status of the Species and Critical Habitat

This opinion examines the status of each species that would be adversely affected by the proposed action. The status is determined by the level of extinction risk that the listed species face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This informs the description of the species' likelihood of both survival and recovery. The species status section also helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. The opinion also examines the condition of critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the current function of the essential physical and biological features that help to form that conservation value.

Species Addressed

The proposed action may affect the Southern Oregon/Northern California Coast (SONCC) coho salmon, California Coastal (CC) Chinook salmon, Northern California (NC) steelhead, and their designated and proposed critical habitats in the action area. Therefore, this opinion analyzes the effects of the proposed action on the SONCC coho salmon, CC Chinook salmon, NC steelhead and their designated critical habitats. The SONCC coho salmon and CC Chinook salmon ESUs include hatchery-born salmon and the NC steelhead DPS includes the North Fork Gualala River Hatchery.

Table 1-1 presents a summary of the *Federal Register* (FR) Notice dates and citations, and geographic distributions for these species and critical habitats. This section of the Opinion updates the status of critical habitat, and population trends at the ESU or DPS scale. Updated information on abundance and distribution, along with an updated description of designated critical habitat in the action area, is provided in the *Environmental Baseline* section of this Opinion.

Table 1-1. The Scientific name, listing status under the ESA, FR notice citation, and geographic distribution of the ESUs and DPS addressed in this Opinion.

	SONCC Coho Salmon ESU	NC Steelhead DPS	CC Chinook Salmon ESU
Scientific Name	*Oncorhynchus* (*O.*) *kisutch*	*O. mykiss*	*O. tshawytscha*
Listing Status	Threatened	Threatened	Threatened
Federal Register Notice	6/28/2005 (70 FR 37160)	ESU listed on June 7, 2000 (65 FR36074) Relisted as DPS January 5, 2006 (71 FR 834)	6/28/2005 (70 FR 37160)
Geographic Distribution	From Cape Blanco, Oregon, to Punta Gorda, California	From Redwood Creek (Humboldt County), southward to, but not including, the Russian River	From Redwood Creek (Humboldt County) south to, and including, the Russian River
Critical Habitat Designation	5/5/1999 (64 FR 24049)	9/2/2005 (70 FR 52488)	9/2/2005 (70 FR 52488)

2.2.1 Species Life History, Distribution, and Abundance

Life history diversity of federally listed species substantially contributes to their persistence, and conservation of such diversity is a critical element of recovery efforts (Beechie *et al.* 2006). Waples *et al.* (2001) and Beechie *et al.* (2006) found that life history and genetic diversity of Pacific salmon and steelhead (*Oncorhynchus* spp.) show a strong, positive correlation with the extent of ecological diversity experienced by a species.

2.2.1.1 NC Steelhead

2.2.1.1.1 ***Life History***

Steelhead probably have the most diverse range of any salmonid life history strategies (Quinn 2005). There are two basic steelhead life history patterns, winter-run and summer-run (Quinn 2005, Moyle 2002). Winter-run steelhead enter rivers and streams from December to March in a sexually mature state and spawn in tributaries to mainstem rivers, often ascending long distances (Moyle 2005). Summer steelhead (also known as spring-run steelhead) enter rivers in a sexually immature state during receding flows of spring and migrate to headwater reaches of tributary streams where they hold in deep pools until spawning the following winter or spring (Moyle 2002). Spawning for all runs generally takes place in the late winter or early spring. Eggs hatch in 3 to 4 weeks and fry emerge from the gravel 2 to 3 weeks later (Moyle 2002). Juveniles spend 1 to 4 years in freshwater before migrating to estuaries and the ocean where they spend 1 to 3 years before returning to freshwater to spawn. "Half pounder" steelhead are sexually immature steelhead that spend about 3 months in estuaries or the ocean before returning to lower river reaches on a feeding run (Moyle 2002). Then they return to the ocean where they spend 1 to 3 years before returning to freshwater to spawn. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby *et al.* 1996). However, it is rare for steelhead to spawn more than twice before dying; most that do so are females (Busby *et al.* 1996). Some steelhead "residualize," becoming resident trout and never adopting the anadromous life history.

2.2.1.1.2 ***Current Distribution and Abundance***

Along the eastern Pacific, rainbow trout, including steelhead, are distributed from Southern California north to Alaska and range west to Siberia (Sheppard 1972). In California, steelhead occur in coastal streams from the Oregon border down to San Diego County and up to barriers to migration throughout their distribution. The NC steelhead DPS includes all naturally spawning populations of steelhead in California coastal river basins from Redwood Creek, Humboldt County to just south of the Gualala River, Mendocino County (Spence *et al*. 2007). This distribution includes the Eel River, the third largest watershed in California, with its four forks (North, Middle, South, and Van Duzen) and their extensive tributaries. Spence *et al.* (2007) identified 32 historically self-sustaining populations in the DPS region based on habitat availability and gene flow among watersheds. An additional 33 small populations are likely dependent upon immigration of non-natal steelhead from the more permanent populations (Bjorkstedt *et al*. 2005). With few exceptions, NC steelhead are present wherever streams are accessible to anadromous fishes and there are sufficient flows. Big and Stone lagoons, between Redwood Creek and Little River, contain steelhead following their opening to the ocean in the early winter, although the source of these fish is unknown (M. Sparkman, personal communication, 2007, Moyle *et al*. 2008).

There is a notable lack of quantitative information on NC steelhead, but there are a few survey index estimates of stock trends. Most data come from fish counts from the 1930s and 1940s at three dams: Sweasey Dam on the Mad River (annual adult average 3,800 in the 1940s), Cape Horn Dam on the upper Eel River (4,400 annual average in the 1930s), and Benbow Dam on the South Fork Eel River (18,784 annual average in the 1940s; Murphy and Shapovalov 1951 *op. cit.,* Shapovalov and Taft 1954, Busby *et al.* 1996). These data can be compared to the annual average at Sweasey Dam at 2,000 in the 1960s, annual average at Cape Horn Dam in the 1980s at 1,000, and annual average at Benbow Dam at 3,355 in the 1970s (McEwan and Jackson 1996, Busby *et al.* 1996). In the mid-1960s, CDFG estimated steelhead spawning in many rivers in this ESU to total about 198,000 (McEwan and Jackson 1996).

Currently, the most comprehensive time series of abundance for a summer steelhead population is for the Middle Fork Eel River, with an average of 780 fish since mid 1960s (Williams *et al.* 2011). Substantial declines from historic levels at major dams indicate a probable decline from historic levels at the DPS scale. Williams *et al.* (2011) concluded that the status of the population had changed little since the 2005 status review. Based on the declining abundance and the inadequate implementation of conservation measures, NMFS concluded that the NC steelhead ESU warranted listing as a threatened species (June 7, 2000, 65 FR 36074).

Steelhead abundance estimates are summarized in the most recent NMFS west coast steelhead status reviews (Williams *et al* 2011). The Biological Review Team (BRT) made a few conclusions, albeit with limited data: (1) population abundances are low, compared to historical estimates; (2) recent trends are downward (except for a few small summer-run stocks), and (3) summer-run steelhead abundance was "very low" (Good *et al.* 2005). Lack of data on run sizes within the DPS was a major source of uncertainty in the BRT's assessment. Williams *et al.* (2011) found little evidence that the status of the NC Steelhead DPS had changed appreciably in either direction since the 2005 status review.

2.2.1.2 CC Chinook Salmon

2.2.1.2.1 ***Life History***

Adult Chinook salmon reach sexual maturity usually at 3 to 5 years, and die soon after spawning. Precocious 2 year olds, especially male jacks, make up a relatively small percentage of the spawning population. Healey (1991) describes two basic life history strategies for Chinook salmon, stream-type and ocean-type, within which there is a tactical component that encompasses variation within race. Like most salmonids, Chinook salmon have evolved with variation in juvenile and adult behavioral patterns, which can help decrease the risk of catastrophically high mortality in a particular year or habitat (Healey 1991). Spring-run Chinook salmon are often stream-type (Healey 1991, Moyle 2002). Adults return to lower-order headwater streams in the spring or early summer before they reach sexual maturity, and hold in deep pools and coldwater areas until they spawn in early fall (Healey 1991, Moyle 2002). This strategy allowed spring-run Chinook salmon to take advantage of mid-elevation habitats inaccessible during the summer and fall due to low flows and high water temperatures (Moyle 2002). Juveniles emerge from the gravel in the early spring and typically spend one year in freshwater before migrating downstream to estuaries and then the ocean (Moyle 2002). A CDFG outmigrant trapping program on the Mad River determined a small proportion of Chinook juveniles will over summer in freshwater (Sparkman, 2002).

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

2.2.1.2.2 ***Current Distribution and Abundance***

Only fall-run Chinook salmon currently occur in the CC Chinook salmon ESU. Spring-run stocks no longer occur in the NCCCRD; however, historical information indicates that spring-run Chinook salmon historically existed in the Mad River and the North Fork and Middle Fork of the Eel River (Keter 1995, Myers *et al*. 1998, Moyle 2002).

California Coastal Chinook salmon are distributed at the southern end of the species' North American range; only Central Valley fall Chinook are found spawning further south. NMFS identified four regions of this portion of the California coast with similar basin-scale environmental and ecological characteristics (Bjorkstedt *et al*. 2005). Sixteen watersheds were identified in these four regions that have minimum amount of habitat available to support independently viable populations. In the *North Mountain-Interior Region*, the Upper Eel and Middle Fork Eel rivers contain independent CC Chinook stocks while the Lower Eel and Van Duzen Rivers have the potential to support viable populations. Chinook salmon are annually observed in the Middle Fork Eel River, in Black Butte River, and near Williams Creek. They continue to be observed annually in the Outlet Creek drainage and in the smaller tributaries feeding Little Lake valley (Scott Harris, personal communication, 2009). In the *North Coastal Region*, Redwood Creek and the Mad, Lower Eel, South Fork Eel, Bear and Mattole Rivers all contain sufficient habitat for independently viable CC Chinook salmon populations. NMFS also identified Little River and Humboldt Bay tributaries as containing potentially independent populations. In the *North-Central Coastal Region*, numerous watersheds in Mendocino County contain (or contained) small runs of CC Chinook salmon that are dependent for persistence upon self-sustaining stocks in Ten Mile, Noyo, and Big Rivers. Along the *Central Coastal Region*, the Navarro, Garcia and Gualala Rivers historically had independent populations but apparently no longer do. Additionally, the Russian River appears to support a self-sustaining population although the role of hatcheries and straying from the Eel River (by fish attracted to Eel River water which has been diverted into the Russian River) is uncertain (Chase *et al*. 2007). Seventeen additional watersheds were tentatively identified by the NMFS to contain dependent CC Chinook salmon, but suggested that only two of these watersheds were consistently occupied by Chinook salmon (Williams *et al.* 2011). While Chinook salmon are also encountered in the

San Francisco Bay region, these fish most likely originated from Central Valley populations and are not included in the ESU (Moyle *et al*. 2008).

Available information on the historical abundance of CC Chinook salmon are summarized in Myers et al. (1998), which states that the 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.

Observed widespread declines in abundance and the present distribution of small populations with sometimes sporadic occurrences contribute to the risks faced in this ESU. This is particularly true for spring-run Chinook salmon. It is possible that Russian River spring-run Chinook salmon within the ESU may have been extirpated. Low abundance, generally negative trends in abundance, reduced distribution, and profound uncertainty as to risk related to the relative lack of population monitoring in California, have contributed to NMFS' conclusion for CC Chinook salmon to be at risk of becoming endangered in the foreseeable future throughout all or a significant portion of their range (September 16, 1999, 64 FR 50394; Good *et al.* 2005).

Good *et al.* (2005) found that historical and current information indicates that CC Chinook salmon populations are depressed in basins where they are being monitored. Uncertainty about abundance, natural productivity, and distribution continues to substantially contribute to risks facing this ESU, specifically in the North-Coastal and North Mountain Interior strata (Willams *et al.* 2011). Concerns about current abundances relative to historical abundances, mixed trends in the few time series available, and potential extirpations in the southern part of the range contributed to the conclusion that CC Chinook salmon are "likely to become endangered" (Good *et al.* 2005). Williams *et al.* (2011) concludes the diminished connectivity between the northern and southern half of the ESU, loss of one diversity stratum, and loss of the spring-run history type is troubling. Overall, uncertainties in populations based on the available data has made it difficult to characterize the status of the ESU and the extinction risk remains the same as in the 2005 status review (Williams *et al.* 2011).

2.2.1.3 SONCC Coho Salmon

2.2.1.3.1 ***Life History***

Adult coho salmon reach sexual maturity at 3 years, and die after spawning. Precocious 2 year olds, especially males, also make up a small percentage of the spawning population. Coho salmon adults migrate and spawn in small streams that flow directly into the ocean, or tributaries and headwater creeks of larger rivers (Sandercock 1991, Moyle 2002). Adults migrate upstream to spawning grounds from September through late December, peaking in October and November. Spawning occurs mainly in November and December, with fry emerging from the gravel in the spring, approximately 3 to 4 months after spawning. Juvenile rearing usually occurs in tributary streams with a gradient of 3 percent or less, although they may move up to streams of 4 percent or 5 percent gradient. Juveniles have been found in streams as small as 1 to 2 meters wide. They may spend 1 to 2 years rearing in freshwater (Bell and Duffy 2007), or emigrate to an estuary shortly after emerging from spawning gravels (Tschaplinski 1988). Coho salmon juveniles are also known to "redistribute" into non-natal rearing streams, lakes, or ponds, often following rainstorms, where they continue to rear (Peterson 1982). At a length of 38 to 45 mm, fry may migrate upstream a considerable distance to reach lakes or other rearing areas (Godfrey 1965 *op. cit.* Sandercock 1991, Nickelson *et al.* 1992). Emigration from streams to the estuary and ocean generally takes place from March through May.

2.2.1.3.2 ***Current Distribution and Abundance***

Reliable current time series of naturally produced adult migrants or spawners are not available for SONCC coho salmon ESU rivers (Good *et al*. 2005). For a summary of historical and current distributions of SONCC coho salmon in northern California, refer to CDFG's (2002) coho salmon status review, historical population structure by Williams *et al.* (2006), as well as the presence and absence update for the northern California portion of the SONCC coho salmon ESU (Brownell *et al.* 1999). Good *et al.* (2005) concluded that SONCC coho salmon were likely to become endangered in the foreseeable future, this conclusion is consistent with an earlier assessment (Weitkamp *et al.* 1995). Although there are few data, the information that is available for SONCC coho salmon indicates the component populations are in decline and strongly suggests the ESU is at risk (Weitkamp *et al.* 1995, CDFG 2002, Good *et al.* 2005). NMFS (2001) concluded that population trend data for SONCC coho salmon from 1989 to 2000 show a continued downward trend throughout most of the California portion of the SONCC coho salmon ESU. Williams *et al.* (2011) reaffirmed both the concerns of the negative population trends of the ESU and the lack of informationfor freshwater survival. These trends should be considered in the context of the low marine survival rates between 2006 and 2011 and likely contributed to the declines in the ESU (Williams *et al.* 2011).

The main stocks in the SONCC coho salmon ESU (Rogue, Klamath, and Trinity Rivers) remain heavily influenced by hatcheries and have little natural production in mainstem rivers (Weitkamp *et al.* 1995, Good *et al.* 2005). The listing of SONCC coho salmon includes all hatchery-produced coho salmon in the ESU range (June 28, 2005, 70 FR 37160). Trinity River Hatchery maintains high production, with a significant number of hatchery SONCC coho salmon straying into the wild population (NMFS 2001). The Mad River Hatchery has ceased coho salmon production in 1999 and Iron Gate Hatchery has reduced production in recent years to a production goal of 75,000 juveniles (FERC 2007). The apparent decline in wild production in these rivers, in conjunction with significant hatchery production, suggests that natural populations of coho salmon are not self-sustaining (Weitkamp *et al.* 1995, Good *et al.* 2005). Coho salmon populations continue to be depressed relative to historical numbers, and there are strong indications that breeding groups have been lost from a significant percentage of streams within their historical range (Good *et al.* 2005).

Brown *et al.* (1994) estimated that the rivers and tributaries in the California portion of the SONCC coho salmon ESU produced an average of 7,080 naturally spawning coho salmon and 17,156 hatchery returns, including 4,480 "native" fish occurring in tributaries having little history of supplementation with nonnative fish. Combining the California run-size estimates with Rogue River estimates, Weitkamp *et al.* (1995) arrived at a rough minimum run-size estimate for the SONCC coho salmon ESU of about 10,000 natural fish and 20,000 hatchery fish.

Brown and Moyle (1991) suggested that naturally-spawned adult coho salmon runs in California streams were less than one percent of their abundance at mid-century, and estimated that wild coho salmon populations in California did not exceed 100 to 1,300 individuals. CDFG (1994) summarized most information for the northern California portion of this ESU, and concluded that "coho salmon in California, including hatchery stocks, could be less than 6 percent of their abundance during the 1940s, and have experienced at least a 70 percent decline in numbers since the 1960's." Further, CDFG (1994) 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 have already been eliminated.

Scientists at the NMFS Southwest Fisheries Science Center compiled a presence-absence database for the SONCC coho salmon ESU similar to that developed by CDFG (Good *et al.* 2005). The data set includes information for coho salmon streams listed in Brown and Moyle (1991), as well as other streams that NMFS found historical or recent evidence of coho salmon presence. The database is a composite of information contained in the NMFS (2001) status review update, additional information gathered by NMFS since publication of the 2001 status review, data used in the CDFG (2002) analysis, and additional data compiled by CDFG (Jong 2002) for streams not on the Brown and Moyle (1991) list. Using the NMFS database, Good *et al.* (2005) compiled information on the presence of coho salmon in streams throughout the SONCC ESU (Figure 2-1), which closely matched the results of Brown and Moyle (1991).

Annually, the estimated percentage of streams in the SONCC coho salmon ESU for which coho salmon presence was detected generally fluctuated between 36 percent and 61 percent between brood years 1986 and 2000 (Figure 2-1). Data reported for the 2001 brood year suggest a strong year class, as indicated by an occupancy rate of more than 75 percent; however, the number of streams for which data were reported is small compared to previous years. The data suggest that, for the period of record, occupancy rates in the SONCC coho salmon ESU were highest (54 to 61 percent) between brood years 1991 and 1997, then declined between 1998 and 2000 (39 to 51 percent) before rebounding in 2001. However, the number of streams surveyed in 2001 was roughly 25 percent of the number surveyed in previous years (Good *et al*. 2005). For a discussion of the current viability of the SONCC coho salmon ESU, please see the *Viability of the ESU/DPS* section of this document.

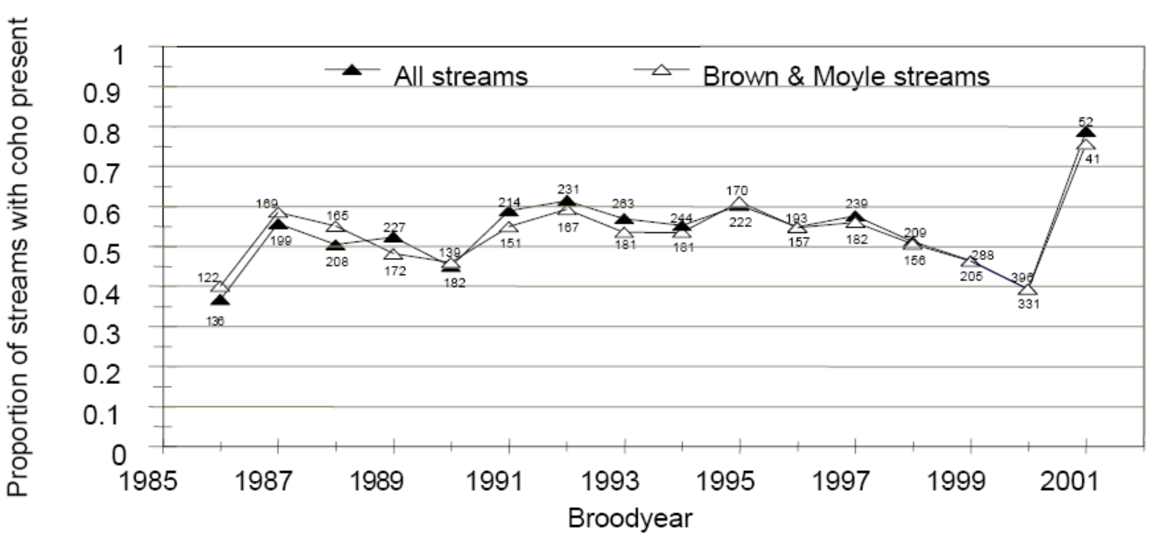

Figure 2-1. Proportion of surveyed streams where coho salmon were detected (Good *et al*., 2005). The number of streams surveyed is shown next to data.

2.2.2 Factors Responsible for Salmonid Decline (ESU or DPS Scale)

The factors that have caused declines in the SONCC coho salmon ESU, CC Chinook salmon ESU, and NC steelhead DPS are similar. These factors include habitat loss due to dam building, degradation of freshwater habitats due to a variety of agricultural and forestry practices, water diversions, urbanization, mining, and severe recent flood events, which are exacerbated by land use practices (Good *et al.* 2005). Sedimentation and loss of spawning gravels associated with poor forestry practices and road building are particularly acute problems that can reduce the productivity of salmonid populations. Nonnative Sacramento pikeminnow (*Ptychocheilus grandis*) occupy the Eel River basin and prey on juvenile salmonids (Good *et al.* 2005) and compete for the same resources. Droughts and unfavorable ocean conditions in the late 1980s and early 1990s were identified as further likely causes of decline (Good *et al.* 2005).

2.2.2.1 Timber Harvest

Timber harvest and associated activities occur over a large portion of the range of the affected species. Timber harvest has caused widespread increases in sediment delivery to channels through both increased landsliding and surface erosion from harvest units and log decks. Much of the riparian vegetation has been removed, reducing future sources of LWD needed to form and maintain stream habitat that salmonids depend on during various life stages.

In the smaller Class II and III streams, recruited wood usually cannot be washed away, so logs remain in place and act as check-dams that store sediment eroded from hillsides (Reid 1998). Sediment storage in smaller streams can persist for decades (Nakamura and Swanson 1993). In assessing the characteristics of Class III watercourses including within the Mad River watershed, Simpson (2002) found that coniferous woody debris was the predominant channel bed grade control. Furthermore, where channels are prone to sediment debris flows, woody debris and adjacent riparian stands can provide roughness that limit the distance debris flows may travel down into channels [Ketcheson and Froehlich 1978 Pacific Watershed Associates (PWA) 1998]. For example, in Bear Creek, a tributary to the Eel River, PWA (1998) noted that debris flows now travel farther downstream and channel aggradation extends farther downstream because of inadequate large wood from landslide source areas and streamside vegetation.

On larger channels, wood again stores sediment, and also provides a critical element in the habitat of aquatic life forms (Spence *et al.* 1996, Reid 1998). Sullivan *et al.* (1987) found that woody debris forms abundant storage sites for sediment in forest streams as large as fourth-order (20 to 50 km^2 drainage area), where storage is otherwise limited by steep gradients and confinement of channels between valley walls. Studies of this storage function in Idaho by Megahan and Nowlin (1976) and in Oregon by Swanson and Lienkamper (1978) indicated that annual sediment yields from small forested watersheds are commonly less than 10 percent of the sediment stored in channels.

In fish-bearing streams, woody debris is important for storing sediment, halting debris flows, and decreasing downstream flood peaks, and its role as a habitat element becomes directly relevant for Pacific salmon species (Reid 1998). LWD alters the longitudinal profile and reduces the local gradient of the channel, especially when log dams create slack pools above or plunge pools below them, or when they are sites of sediment accumulation (Swanston 1991).

Cumulatively, the increased sediment delivery and reduced 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 reduce 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 streams that support salmonids.

2.2.2.2 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. Land sliding and chronic surface erosion from road surfaces are large sources of sediment across the affected species' ranges. Roads also have the potential to increase peak flows and reduce summer base flows with consequent effects on the stability of stream substrates and banks. Roads have led to widespread impacts on salmonids by increasing the sediment loads. The consequent impacts on habitat include reductions in spawning, rearing and holding habitat, and increases in turbidity.

The delivery of sediment to streams can be generally considered as either chronically delivered, or more episodic in nature. Chronic delivery, or surface erosion, occurs through rainsplash and overland flow. Therefore, surface erosion occurs often and is associated with rainfall. More episodic delivery, on the order of every few years, occurs in the form of mass wasting events, or landslides, that deliver large volumes of sediment during large storm events.

Road construction, use, and maintenance, tree-felling, log hauling, slash disposal, site preparation for replanting, and soil compaction by logging equipment are all potential sources of fine sediment that could ultimately deliver to streams in the action area (Hicks *et al.* 1991, Murphy 1995). The potential for delivering sediment to streams increases as hillslope gradients increase (Murphy 1995). The soils in virgin forests generally resist surface erosion because their coarse texture and thick layer of organic material and moss prevent overland flow (Murphy 1995). All of the activities associated with timber management in the action area have previously been known to decrease the ability of forest soils to resist erosion and contribute to the production of non-point sources of stream pollution by fine sediment. Yarding activities that cause extensive soil disturbance and compaction can increase splash erosion and channelize overland flow. Site preparation and other actions which result in the loss of the protective humic layer can increase the potential for surface erosion (Hicks *et al.* 1991). Controlled fires can also consume downed wood that had been acting as sediment dams on hillslopes. After harvesting, root strength declines, often leading to slumps, landslides, and surface erosion (FEMAT 1993, Thomas *et al.* 1993). Riparian tree roots provide bank stability and streambank sloughing and erosion often increases if these trees are removed, leading to increases in sediment and loss of overhanging banks, which are important habitat for rearing Pacific salmonids (Murphy 1995).

Where rates of timber harvest are high, the effects of individual harvest units on watercourses are cumulative. Therefore, in sub-watersheds where timber harvest is concentrated in a relatively short period of time, we expect that fine sediment impacts will be similarly concentrated.

Construction of road networks can also greatly accelerate erosion rates within a watershed (Haupt 1959, Swanson and Dyrness 1975, Swanston and Swanson 1976, Reid and Dunne 1984, Hagans and Weaver 1987). Once constructed, existing road networks are a chronic source of sediment to streams (Swanston 1991) and are generally considered the main cause of accelerated surface erosion in forests across the western United States (Harr and Nichols 1993). Processes initiated or affected by roads include landslides, surface erosion, secondary surface erosion (landslide scars exposed to rainsplash), and gullying. Roads and related ditch networks are often connected to streams via surface flow paths, providing a direct conduit for sediment. Where roads and ditches are maintained periodically by blading, the amount of sediment delivered continuously to streams may temporarily increase as bare soil is exposed and ditch roughness features which store and route sediment and also armor the ditch are removed. Hagans and Weaver (1987) found that fluvial hillslope erosion associated with roads in the lower portions of the Redwood Creek watershed produced about as much sediment as landslide erosion between 1954 and 1980. In the Mattole River watershed, which is south of the action area, the Mattole Salmon Group (1997) found that roads, including logging haul roads and skid trails, were the source of 76% of all erosion problems mapped in the watershed, although this figure does not specifically address road surface erosion. It does suggest that, overall, roads are a primary source of sediment in managed watersheds. Road surface erosion is particularly affected by traffic, which increases sediment yields substantially (Reid and Dunne 1984). Other important factors that affect road surface erosion include condition of the road surface, timing of when the roads are used in relation to rainfall, road prism moisture content, location of the road relative to watercourses, methods used to construct the road, and steepness on which the road is located.

2.2.2.3 Hatcheries

Hatchery operations potentially conflict with salmon recovery in the action area. Three large mitigation hatcheries release roughly 14,215,000 hatchery salmonids into SONCC coho salmon ESU rivers annually. Additionally, a few smaller hatcheries, such as Mad River Hatchery and Rowdy Creek Hatchery (Smith River) add to the production of hatchery fish. Both intra- and inter-specific interactions between hatchery and wild salmonids occur in freshwater and saltwater.

Spawning by hatchery salmon is often not controlled (ISAB 2002). Hatchery fish also stray into other rivers and streams, transferring genes from hatchery populations into naturally spawning populations (Pearse *et al.* 2007). This is thought to be problematic because hatchery programs alter the genetic composition (Reisenbichler and Rubin 1999; Ford 2002), phenotypic traits (Hard *et al.* 2000; Kostow 2004), and behavior (Berejikian *et al.* 1996; Jonsson 1997) of reared fish. These genetic interactions between hatchery and naturally produced stocks decrease the amount of genetic and phenotypic diversity of a species by homogenizing once disparate traits of hatchery and natural fish. The result has been progeny with lower survival (McGinnity *et al.* 2003; Kostow 2004) and ultimately, a reduction in the fitness of the natural stock (Reisenbichler and McIntyre 1977; Chilcote 2003; Araki *et al.* 2007) and outbreeding depression (Reisenbichler and Rubin 1999; HSRG 2009).

Flagg *et al.* (2000) found that, except in situations of low wild fish density, increasing releases of hatchery fish leads to displacement of wild fish from portions of their habitat. Competition between hatchery- and naturally-produced salmonids has also been found to lead to reduced growth of naturally produced fish (McMichael *et al.* 1997). Kostow *et al.* (2003) and Kostow and Zhou (2006) found that over the duration of the steelhead hatchery program on the Clackamas River, Oregon, the number of hatchery steelhead in the upper basin regularly caused the total number of steelhead to exceed carrying capacity, triggering density-dependent mechanisms that impacted the natural population. Competition between hatchery and natural salmonids in the ocean has also been shown to lead to density-dependent mechanisms that affect natural salmonid populations, especially during periods of poor ocean conditions (Beamish *et al.* 1997a; Levin *et al.* 2001; Sweeting *et al.* 2003).

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, and attempted to cultivate a run of non-indigenous summer steelhead within the Mad River. CDFG ended these practices in 1996. The currently operating Mad River Hatchery, Trinity River Hatchery and Iron Gate Hatchery operate in the action area and have all been identified as having potentially harmful effects to wild salmon populations.

2.2.2.4 Water Diversions and Habitat Blockages

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

Habitat blockages have occurred in relation to road construction as discussed previously. However, hydropower, flood control, and water supply dams of different municipal and private entities, particularly in the Klamath Basin, have permanently blocked or hindered salmonid access to historical spawning and rearing grounds. Since 1908, the construction of the Potter Valley Project dams has blocked access to a majority of the historic salmonid habitat within the Eel River watershed. The percentage of habitat loss for steelhead is presumable greatest, because steelhead were more extensively distributed upstream than Chinook salmon. As a result of migrational barriers, salmon and steelhead populations have been confined to lower elevation mainstems that historically only were used for migration and rearing. Population abundances have declined in many streams due to decreased quantity, quality, and spatial distribution of spawning and rearing habitat. Higher temperatures at these lower elevations during late-summer and fall are also a major stressor to adult and juvenile salmonids.

2.2.2.5 Predation

Predation was not believed to play a major role in the decline of salmon populations; however, it may have had substantial impacts at local levels. 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, populations of California sea lions and Pacific harbor seals, known predators of salmonids which occur in most estuaries and rivers where salmonid runs occur on the West Coast, have increased to historical levels because harvest of these animals has been prohibited by the Marine Mammal Protection Act of 1972 (Fresh 1997). 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 (May 6, 1997, 62 FR 24588), for example, NOAA Fisheries 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. NOAA Fisheries (1997) determined that although pinniped predation did not cause the decline of salmonid populations, predation may preclude recovery of these populations in localized areas where they co-occur with salmonids (especially where salmonids concentrate or passage may be constricted). Specific areas where pinniped predation may preclude recovery cannot be determined without extensive studies.

Normally, predators play an important role in the ecosystem, culling out unfit individuals, thereby strengthening the species as a whole. The increased impact of certain predators has been, to a large degree, the result of ecosystem modification. Therefore, it would seem more likely that increased predation is but a symptom of a much larger problem, namely, habitat modification and a decrease in water quantity and quality. With the decrease in quality riverine and estuarine habitats, increased predation by freshwater, avian, and marine predators will occur. Without adequate avoidance habitat (e.g., deep pools and estuaries, and undercut banks) and adequate migration and rearing flows, predation may play a role in the reduction of some coho salmon populations.

2.2.2.6 Disease

Relative to effects of overfishing, habitat degradation, and hatchery practices, disease is not believed to have been a major cause in the decline of salmon populations. However, disease may have substantial impacts in some areas and may limit recovery of local salmon populations. Although naturally occurring, many of the disease issues salmon currently face have been exacerbated by human-induced environmental factors such as water regulation (damming and diverting) and habitat alteration.

Salmonids are exposed to numerous bacterial, protozoan, viral, and parasitic organisms in spawning and rearing areas, hatcheries, migratory routes, and the marine environment. However, disease results only when the complex interaction among host, pathogen, and environment is altered. Natural populations of salmon have co-evolved with diseases that are endemic to the areas they inhabit and have developed levels of resistance to these pathogens. In general, diseases do not cause significant mortality in native coho salmon stocks in natural habitats (Bryant 1994; Shapovalov and Taft 1954), however, our understanding of mortality caused by pathogens in the wild is limited by the difficulty in determining the proximate and ultimate causes of death (e.g. when fish weakened by disease are consumed by predators). Within the last few decades, the introduction and prevalence of disease into wild stocks has become an increasing concern.

Ceratomyxosis, which is caused by *C. shasta*, has recently been identified as one of the most significant disease for juvenile salmon due to its prevalence and impacts in the Klamath Basin (Nichols *et al.* 2007). Mortality rates from temporary and longer term exposures at various locations in the Klamath River vary between location, months and years, but are consistently high (10-90%) (Stocking *et al*. 2006). Adults in the Klamath basin are also largely impacted by disease, primarily from the common pathogens *Ichthyopthirius multifilis* (Ich) and *Flavobacterium columnare* (columnaris) (NRC 2004). These pathogens were responsible for the 2002 fish kill on the Klamath River. Adult mortality from ich and columnaris are not as common as juvenile mortality from *C. Shasta* or *Parvicapsula minibicornis*. 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).

2.2.2.7 Fish Harvest

Salmon and steelhead once supported important tribal, commercial, and recreation fisheries in the action area. Harvest of adult salmonids for commercial and recreational fisheries has been identified as a significant factor in their decline. The proportion of harvest taken by sport and commercial harvesters has varied over the years according to abundance and social and economic priorities. Steelhead are rarely caught in the ocean fisheries. Ocean salmon fisheries are managed by NMFS to achieve Federal conservation goals for west coast salmon in the Pacific Coast Salmon Fishery Management Plan (FMP). The goals specify numbers of adults that must be allowed to spawn annually, or maximum allowable adult harvest rates. The key stocks in California are Klamath River fall-run Chinook salmon and Sacramento River fall-run Chinook salmon. In addition to the FMP goals, salmon fisheries must meet requirements developed through NMFS intra-agency section 7 consultations.

NMFS ESA consultation standard/recovery plan for the Eel, Mattole, and Mad River stocks requires that the projected ocean harvest rates on age-4 Klamath River fall Chinook not exceed 16 percent. CDFG is developing an assessment and monitoring program for the Eel, Mattole, Mad, and Smith Rivers Fall and Spring Chinook to better develop management goals (PFMC, 2006).

In addition to the reduction in numbers of spawners, ocean salmon fisheries may reduce the viability of Chinook salmon populations through negative effects on demographics. The sequential interception of immature fish by ocean fisheries results in a reduction in the proportion of a cohort that spawns as older, larger fish. The reduction in the average age of spawning would be further intensified by genetic changes in the population due to the heritability of age of maturation (Ricker 1980, Hankin and McKelvey 1985, Hankin and Healey 1986). The higher productivity of larger and older female Chinook salmon results from the larger size and number of eggs they carry (Healy and Heard 1984) as well as their ability to spawn in larger substrates and create deeper egg pockets (Van den Berge and Gross 1984, Ricker 1980, Shelton 1955). This reduces scour potential, which may be especially important to the productivity of redds in areas subject to high sediment loads and scour, such as those found in streams included in the action area for this consultation.

Ocean exploitation rates have dropped substantially in response to the non-retention regulations put in place in 1994 as well as general reductions in Chinook-directed effort. Directed river harvest of coho salmon has not been allowed within the SONCC coho salmon ESU since 1994, with the exception of sanctioned tribal harvest for subsistence, ceremonial, and commercial purposes by the Yurok, Hoopa Valley, and Karuk tribes (CDFG 2002c). SONCC-origin coho salmon that migrate north of Cape Blanco experience incidental morality due to hooking and handling in this fishery; however, total incidental mortality from this fishery and Chinook-directed fisheries north of Humbug Mountain has been estimated to be less than 7% of the total mortality of coho salmon since 1999 (PFMC 1999, 2000, 2001a, 2002c, 2003b).

Since 1998, total fishery impacts have been limited to no more than 13 percent on Rogue/Klamath hatchery coho (surrogate stock) and no retention of coho in California ocean fisheries. Only marked hatchery coho salmon are allowed to be harvested in the Rogue and Klamath Rivers. All other recreational coho salmon fisheries in the Oregon portion of the ESU are closed. Recovery management may last more than 10 years even with no fishery impacts due to loss or deterioration of significant portions of freshwater habitat and ongoing unfavorable marine conditions.

Coho salmon harvested by Native American tribes is primarily incidental to larger Chinook salmon subsistence fisheries in the Klamath and Trinity Rivers. In neither basin is tribal harvest considered to be a major factor for the decline of coho salmon. The Yurok fishery has been monitored since 1992 and during that time harvest has ranged from 27 to 1,168 fish caught annually. Based on estimates of upstream escapement (in-river spawners and hatchery returns) this fishery is thought to amount to an average harvest rate of 4.4 percent for the period (CDFG 2004). Harvest management practiced by tribes is conservative and has resulted in limited impacts on stocks

The commercial and recreational ocean fisheries for salmon and steelhead were closed in 2008 due to record low returns of Sacramento River fall-run Chinook, and were extended through the 2009-2010 fishing season. The only exception to the 2009-2010 closure was a ten-day recreational ocean salmon season along the northern California coast targeting Klamath River fall-run Chinook, due to projected spawner estimates surpassing conservation goals. The closure of the commercial and recreational fisheries is believed to decrease incidental take of listed salmonids, and therefore assist in their recovery.

2.2.2.8 Climate Change

One factor affecting the rangewide status of SONCC coho salmon, CC Chinook salmon, and NC steelhead and aquatic habitat at large is climate change. Climate change is expected to detrimentally affect SONCC coho salmon, CC Chinook salmon, and NC steelhead in freshwater, estuarine, and ocean habitats (Williams et al. 2011a, 2011b, 2011c; NMFS 2014). Climate change affects the rangewide status of SONCC coho salmon, CC Chinook salmon, and NC steelhead by altering their aquatic habitat through freshwater temperature regimes which are exacerbated when degraded riparian conditions already support fewer salmon than historical, unaltered conditions. Climate change can play a major role in the life cycle, productivity, and persistence of coho and Chinook salmon, and steelhead populations and can cause extreme conditions that can be catastrophic to salmonid populations (Battin et al. 2007; Waples et al. 2009; Mantua et al. 2010).

The effects of climate change on SONCC coho salmon, CC Chinook salmon, and NC steelhead create the possibility of less-productive ocean conditions and warming of freshwater that increases bioenergetic and disease stresses on anadromous fish. In addition, as climate change reduces the carrying capacity of the habitat within the range of SONCC coho salmon, CC Chinook salmon, and NC steelhead species viability may be more difficult to achieve (Waples 2002; Wade et al. 2013; NMFC 2014). The reduced genetic diversity resulting from depressed population size may limit the ability of individuals to adapt to changing climatic conditions (Beechie et al. 2006; McClure et al. 2007; Waples et al. 2008). For those populations already limited by thermal stress, distribution, migratory alterations, and developmental processes associated with overall population fitness, climate change will likely further alter and/or disrupt those populations (Mantua et al. 2010).

Climate change is postulated to have a negative impact on salmonids throughout the Pacific Northwest due to large reductions in available freshwater habitat (Battin *et al.* 2007). Widespread declines in springtime snow water equivalent (SWE), which is the amount of water contained in the snowpack, have occurred in much of the North American West since the 1920s, especially since mid-century (Knowles and Cayan 2004, Mote 2006). This decrease in SWE can be largely attributed to a general warming trend in the western United States since the early 1900s (Mote *et al.* 2005, Regonda *et al.* 2005, Mote 2006), even though there have been modest upward precipitation trends in the western United States since the early 1900s (Hamlet *et al.* 2005). The largest decreases in SWE are taking place at low to mid elevations (Mote 2006, Van Kirk and Naman 2008) because the warming trend overwhelms the effects of increased precipitation (Hamlet *et al.* 2005, Mote *et al.* 2005, Mote 2006). These climactic changes have resulted in earlier onsets of springtime snowmelt and streamflow across western North America (Hamlet and Lettenmaier 1999, Regonda *et al.* 2005, Stewart *et al.* 2005), as well as lower flows in the summer (Hamlet and Lettenmaier 1999, Stewart *et al.* 2005).

The projected runoff-timing trends over the course of the twenty first century are most pronounced in the Pacific Northwest, Sierra Nevada, and Rocky Mountain regions, where the eventual temporal centroid of streamflow (*i.e.*, peak streamflow) change amounts to 20 to 40 days in many streams (Stewart *et al.* 2005). Although climate models diverge with respect to future trends in precipitation, there is widespread agreement that the trend toward lower SWE and earlier snowmelt will continue (Zhu *et al*. 2005; Vicuna *et al*. 2007). Thus, availability of water resources under future climate scenarios is expected to be most limited during the late summer (Gleick and Chalecki 1999; Miles *et al*. 2000). A one-month advance in timing centroid of streamflow would also increase the length of the summer drought that characterizes much of western North America, with important consequences for water supply, ecosystem, and wildfire management (Stewart *et al.* 2005). These changes in peak streamflow timing and snowpack will negatively impact salmonid populations due to habitat loss associated with lower water flows, higher stream temperatures, and increased human demand for water resources.

The global effects of climate change on river systems and salmon are often superimposed upon the local effects of logging, water utilization, harvesting, hatchery interactions, and development within river systems (Bradford and Irvine 2000; Mayer 2008; Van Kirk and Naman 2008). For example, total water withdrawal in California, Idaho, Oregon and Washington increased 82 percent between 1950 and 2000, with irrigation accounting for nearly half of this increase (MacKichan 1951; Hutson *et al.*, 2004), while during the same period climate change was taking place.

2.2.2.9 Ocean Conditions

Variability in ocean productivity has been shown to affect fisheries production both positively and negatively (Chavez *et al.* 2003). Beamish and Bouillion (1993) showed a strong correlation between North Pacific salmon production and marine environmental factors from 1925 to 1989. Beamish *et al.* (1997b) noted decadal-scale changes in the production of Fraser River sockeye salmon that they attributed to changes in the productivity of the marine environment. Warm ocean regimes are characterized by lower ocean productivity (Behrenfeld *et al.* 2006, Wells *et al.* 2006), which may affect salmon by limiting the availability of nutrients regulating the food supply, thereby increasing competition for food (Beamish and Mahnken 2001). Data from across the range of coho salmon on the coast of California and Oregon reveal there was a 72 percent decline in returning adults in 2007/08 compared to the same cohort in 2004/05 (MacFarlane *et al.* 2008). The Wells Ocean Productivity Index, an accurate measure of Central California ocean productivity, revealed poor conditions during the spring and summer of 2006, when juvenile coho salmon and Chinook salmon from the 2004/05 spawn entered the ocean (McFarlane *et al.* 2008). Data gathered by NMFS suggests that strong upwelling in the spring of 2007 may have resulted in better ocean conditions for the 2007 coho salmon cohort (NMFS 2008). The quick response of salmonid populations to changes in ocean conditions (MacFarlane *et al.* 2008) strongly suggests that density dependent mortality of salmonids is a mechanism at work in the ocean (Beamish *et al.* 1997a, Levin *et al.* 2001, Greene and Beechie 2004).

2.2.2.10 Marine Derived Nutrients

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

2.2.3 <u>Viability of the ESUs/DPS</u>

An ESU or DPS is made up of multiple populations. The viability of an ESU or DPS can be assessed by considering the viability of its component populations, and the effects of a proposed action on an ESU or DPS can be assessed by first considering the effects of the proposed action on its component populations. To integrate population information into viability criteria at the ESU/DPS scale, NMFS has identified "diversity strata", which are "groups of populations that span the diversity and distribution that currently exists or historically existed within an ESU" (Bjorkstedt *et al.* 2005). Diversity strata account for the important variability that exists in environments and in the physical characteristics and genetic makeup of salmonids. Bjorkstedt *et al.* (2005) and Williams *et al*. (2006) provide a set of rules that are expected to result in certain configurations of populations within each diversity stratum that they believe will result in a viable ESU. A population is part of a particular diversity stratum, which is part of a particular ESU or DPS. The ESU or DPS cannot be considered viable unless all its diversity strata are viable, and each diversity stratum cannot be considered viable unless its populations meet the criteria described by Bjorkstedt *et al.* (2005) and Williams *et al.* (2006). A diversity stratum could be considered viable even if one or more of its component populations were not viable, if the remaining populations m*et al*l the viability characteristics including, abundance, productivity, diversity, and spatial structure (McElhany 2002, Bjorkstedt *et al*. 2005, Williams *et al*. 2006).

Consideration of the viability of all diversity strata within a particular ESU or DPS is beyond the scope of this Opinion. This Opinion will consider the viability of the SONCC coho salmon ESU, CC Chinook salmon ESU, and the NC steelhead DPS. Then the viability of the affected populations of salmon and steelhead will be discussed in the Environmental Baseline section. Finally, the impacts of the Project on the viability of the populations of salmon and steelhead, and the implications for viability of the ESUs and DPS, will be analyzed in the *Effects of the Action* section.

In order to determine the current viability of each ESU or DPS, we use the concept of a Viable Salmonid Population (VSP) and the parameters for evaluating populations described by McElhany *et al.* (2000). The four parameters are population size, productivity, spatial structure, and diversity. Each parameter is described below, followed by an assessment of the viability of each parameter for each ESU or DPS which may be affected by the project.

Status reviews for the SONCC coho salmon ESU, CC Chinook salmon ESU and the NC steelhead DPS concluded data were insufficient to set specific numeric population size targets for viability (Spence *et al.* 2007, Williams *et al.* 2007). However, NMFS released the SONCC Coho Recovery Plan in 2014 which provides spawner abundance requirements for SONCC coho salmon ESU viability. NMFS developed spawner estimates for each population within the proposed action area, which are as follows: Lower Trinity River (3,600), Lower Eel/Van Duzen River Populations (7,900), South Fork Eel River (9,300), and the Mattole River (1,000) (NMFS 2014). Currently, NMFS is developing a Multi-Species Recovery plan addressing CC Chinook and NC steelhead which will provide a target spawner estimates for ESU/DPS population viability. However, in the absence of such targets, McElhany *et al.* (2000) suggested ESUs ". . . have been historically self-sustaining and the historical number and distribution of populations serves as a useful 'default' goal in maintaining viable ESUs."

2.2.3.1 Population Size

Information about population size provides an indication of the sort of extinction risk that a population faces. For instance, smaller populations are at a greater risk of extinction than large populations because the processes that affect populations operate differently in small populations than in large populations (McElhany *et al.* 2000). One risk of low population sizes is depensation. Depensation occurs when populations are reduced to very low densities and per capita growth rates decrease as a result of a variety of mechanisms [*e.g.*, failure to find mates and therefore reduced probability of fertilization, failure to saturate predator populations (Liermann and Hilborn 2001)]. Depensation results in a negative feedback that accelerates a decline toward extinction (Williams *et al.* 2007).

The final rule for the ESA listing of the CC Chinook ESU (June 28, 2005, 70 FR 37160) stated "an assessment of the effects of [multiple] small artificial propagation programs on the viability of the ESU in-total concluded that they collectively decrease risk to some degrees by contributing to local increases in abundance . . ." However, McElhany *et al*. (2000) cautioned, "note that the ESA's primary focus is on natural populations in their native ecosystems, so when we evaluate abundance to help determine VSP status, it is essential to focus on naturally produced fish (*i.e*., the progeny of naturally-spawning parents)." Based on these guidance documents, to the extent that hatchery-reared parents may boost production of naturally produced fish if and when they spawn in the wild, they may benefit the VSP parameter of population size. However, a population cannot be considered viable unless it has the minimum number of *naturally produced* spawners identified in recent guidance documents (Spence *et al*. 2007, Williams *et al*. 2007). Although the operation of a hatchery tends to increase the abundance of returning adults (70 FR 37160), the reproductive success of hatchery-born salmonids spawning in the wild is far less than that of naturally produced ones (Araki *et al*. 2007). As a result, the higher the proportion of hatchery-born spawners, the lower the productivity of the population, as demonstrated by Chilcote (2003). Chilcote (2003) examined the actual number of spawners and subsequent recruits over 23 years in 12 populations of Oregon steelhead with varying proportions of hatchery-origin spawners and determined ". . . a spawning population comprised of equal numbers of hatchery and wild fish would produce 63 percent fewer recruits per spawner than one comprised entirely of wild fish."

Population trend data for fish spawned and reared entirely within the action area are unavailable. However, overall population trends for the entire Eel River reflect at least an 80 percent decline in salmon and steelhead from the early 1960s, and roughly a 97 percent decline over the last century (Table 2-6).

Table 2-6. Estimates of Eel River anadromous adult salmonid escapement.

	Estimate of Individuals			
Era	**Coho salmon**	**Chinook salmon**	**Steelhead**	**Reference**
1900	70,000(1)	175,000(1)	255,000(1)	CDFG (1997)
1964	14,000	55,500	82,000	CDFG (1965)
late 1980's	1,000	10,000	20,000	CDFG (1997)
2003	<1,000(2)	<5,000	<9,000	
(1) – NMFS estimate based upon 1964 run proportions. (2) - NMFS estimate of wild runs averaged over the last 10 years				

Fish counts at Benbow Dam near Garberville indicate a dramatic decline in all three species from 1938–1975 (Figure 2-2). These populations have undergone the most serious declines following the 1955 and 1964 floods (CDFG 1996). Salmonid population declines have been attributed to land management activities, drought, ocean conditions, and proliferation of non-native fish species (EPA 1999, Bjorkstedt *et al*. 2005) and major floods.

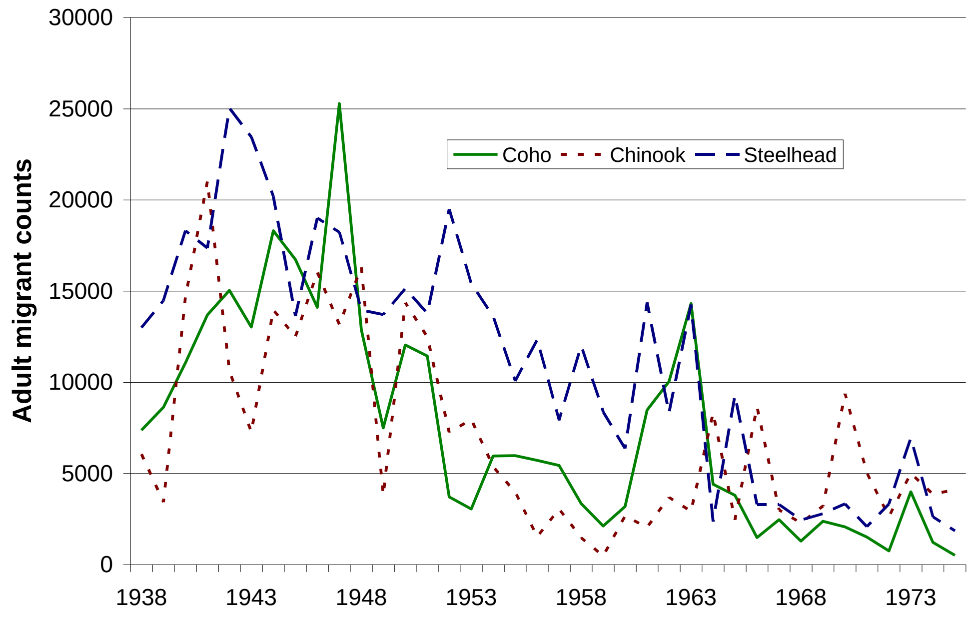

Figure 2-2. Annual counts of adult migrant coho salmon, Chinook salmon, and steelhead at Benbow Dam on the South Fork Eel River (near Garberville) from 1938–1975. Note: these abundance numbers represent a minimum population for the South Fork Eel River watershed given that salmon bound for downstream tributaries downstream of Benbow Dam would not be counted. (Data from CalFish [http://www.calfish.org/])

The California Department of Water Resources (CDWR 1965) characterized the Eel River as "…one of California's most important anadromous fish streams; ranking second in silver [coho] salmon and steelhead trout production, and third in king [Chinook] salmon production." The most recent population estimates of 10,000 natural SONCC coho salmon (Weitkamp *et al.* 1995), when compared to estimates by NMFS of Eel River coho salmon runs of less than 1,000 fish (approximately 10 percent of the ESU) indicate that the Eel River population is important to the overall ESU, and implies that a self-sustaining and self-regulating Eel River population will be necessary for the recovery of SONCC coho salmon. Summer surveys of coho salmon juveniles in index regions of the South Fork Eel River watershed did not reveal obvious trends in abundance. CDFG (1965) estimated that approximately 500 coho salmon annually migrated up the Van Duzen River and 500 in the mainstem Eel River. Two decades later, the escapement estimate for 1984-1985 declined to 200 for each (Wahle and Pearson 1987). More recently, the 1996, 1997, and 1999 year classes were relatively strong, whereas the 1995, 1998, and 2000 year classes were comparatively weak (NMFS 2001).

Similarly, the Eel River is also important for the recovery of the CC Chinook salmon ESU and NC steelhead ESU. CDFG (1965) estimated Eel River Chinook salmon spawning escapement at 55,500, which represented 73 percent of the Chinook salmon production in the CC Chinook salmon ESU (CDFG 1965). However, partial counts in the Eel River indicate escapement slightly exceeding 4,000 Chinook salmon and an overall negative trend (-0.02 percent, Meyers *et al.* 1998) since the late 1980s. CDFG (1965) also estimated that approximately 2,500 Chinook salmon annually migrated up the Van Duzen River. Eel River steelhead spawning escapement in 1964 was estimated at 82,000, about 41 percent of the overall production of the NC steelhead ESU (Busby *et al.* 1996). The summer steelhead run in the Van Duzen River is generally considered to be less than 100 adults (Higgins *et al.* 1992). Annual adult summer steelhead monitoring conducted under LOP 2004-1 is summarized in Table 2-7 to show the low number of adults that are typically encountered.

Table 2-7. Adult summer steelhead survey results for the lower Eel River (*i.e.*, downstream of the Van Duzen River), 1996-2002 (Halligan 2003).

Survey year	Total number observed*
1996	0
1997	11
1998	1
1999	8
2000	18
2001	20
2002	7
*Totals do not include hatchery fish or half-pounders.	

Comprehensive salmonid population estimates have not been completed for the sections and tributaries of the Eel River evaluated in VSP documents for each species. However, it is clear the numbers of coho salmon, Chinook salmon, and steelhead in the Eel River are extremely low compared to historic conditions. McElhany *et al.* (2000) suggests that it is reasonable to assume historical population sizes were viable, and that the further population abundance strays from historic levels, the higher the probability the population is not viable. Based on this criterion, the abundance of salmon and steelhead in the Eel River system is so low it is highly likely these populations are not viable. Table 2-8 displays thresholds below which populations are at high risk of extinction from depensation. Depensation occurs when populations are reduced to very low densities and per capita growth rates decrease as a result of a variety of mechanisms (*e.g.*, failure to find mates and therefore reduced probability of fertilization, failure to saturate predator populations; Liermann and Hilborn 2001).

Table 2-8. Depensation thresholds for specific salmonid populations

Population	Depensation Threshold (spawner number)	Extinction Risk	Population	Depensation Threshold (spawner number)
CC Chinook			**NC Steelhead (summer)**	
Lower Eel River	594		Van Duzen River	362
Entire Eel River	1,089		South Fork Eel River	1,182
			Middle Fork Eel River	581
SONCC Coho			Bucknell Creek	21
Lower Eel/Van Duzen River	394	High	Entire Eel River watershed[a]	3,323
South Fork Eel River	464	Moderate		
Mainstem Eel River	232	High	**NC Steelhead (winter)**	
North Fork Eel River	54	High	Entire Eel River watershed[a]	3,323
Middle Fork Eel River	78	High		
Middle Mainstem Eel River	256	High		
Entire Eel River watershed	1,652	High		

Source: Spence *et al.* 2008, Williams *et al.* 2007

2.2.3.1.1 ***NC Steelhead***

Steelhead abundance has been monitored at three dams in the NC steelhead ESU since the 1930s. Reviewers participating in the most recent status review determined these data showed population abundances were low relative to historical estimates, and that summer-run steelhead abundance was very low (Williams *et al.* 2011). Regarding abundance, reviewers concluded "Although there are older data for several of the larger river systems that imply run sizes became much reduced since the early twentieth century, there are no recent data suggesting much of an improvement" (Good *et al.* 2005). Experts consulted during the status review gave this DPS a risk score of 3.7 (out of 5, with 5 equaling the highest risk) for the abundance category (Good *et al.* 2005), indicating its reduced abundance contributes significantly to long-term risk of extinction, and may contribute to short-term risk of extinction in the foreseeable future. NMFS concludes this DPS falls far short of McElhany's 'default' goal of historic population numbers and distribution and is therefore not viable in regards to the population size VSP parameter.

2.2.3.1.2 ***CC Chinook Salmon***

The most recent status review found continued evidence of: (1) low population sizes relative to historical abundance, (2) mixed trends in the few time series of abundance indices available for analysis, and (3) low abundances and potential extirpations of populations in the southern part of the ESU (Williams *et al.* 2011). The distribution of Chinook salmon in this ESU continues to be curtailed or blocked by dams in the Eel and Russian River basins. As noted above, Peters Dam in the Lagunitas Creek watershed curtailed or blocked access to historic Chinook salmon spawning and rearing habitat (NMFS 1998); however, it was not part of the listed ESU because it is south of the current ESU boundary at the Russian River. New information on the presence of Chinook salmon in the Lagunitas Creek watershed and genetic data suggesting these fish are most likely part of the CC Chinook salmon ESU led to the SWFSC's recommendation that the southern boundary of this ESU be extended southward to include all coastal watersheds north of the Golden Gate, including Lagunitas Creek. If this boundary change is implemented through formal rulemaking, Peters Dam on Lagunitas Creek will be identified as further curtailing Chinook salmon habitat in this ESU (Williams et al. 2011b). NMFS concludes this ESU falls far short of McElhany's 'default' goal of historic population numbers and distribution and is therefore not viable in regards to the population size VSP parameter.

2.2.3.1.3 ***SONCC Coho Salmon***

The most recent status review concluded SONCC coho salmon populations ". . . continue to be depressed relative to historical numbers, and [there are] strong indications that breeding groups have been lost from a significant percentage of streams within their historical range (Williams *et al.* 2011)." The distribution of coho salmon within the SONCC ESU is reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which they are now absent (NMFS 2001a; Good *et al.* 2005; Williams *et al.* 2011a; NMFS 2014). Scientists at the NMFS Southwest Fisheries Science Center compiled a presence-absence database for SONCC coho salmon ESU-wide, using information for coho salmon streams listed in Brown and Moyle (1991), other streams where NMFS found historical or recent evidence of coho salmon presence, and information assembled in the 2002 Status Review of California coho salmon North of San Francisco (CDFG 2002). Using the NMFS database, Good *et al.* (2005) compiled information on the presence of coho salmon in streams throughout the SONCC coho salmon ESU, which closely matched the results of Brown and Moyle (1991). Good et al. (2005) also noted that they had strong indications that breeding groups have been lost from a significant percentage of streams within their historical range. Relatively low levels of observed presence in historically occupied coho salmon streams (between 36 and 61 percent from 1986–2000) indicate continued low abundance in the California portion of the SONCC coho salmon ESU (Good et al. 2005). Data reported for the 2001 brood year suggest a strong year class, as indicated by an occupancy rate of more than 75 percent; however, the number of streams for which data were reported was roughly 25 percent of the number surveyed in previous years (Good et al. 2005). The data suggest that, for the period of record, occupancy rates within the SONCC coho salmon ESU were higher, between 54 and 61%, from brood years 1991–1997, compared to brood years 1998–2000, between 39 and 51%, before increasing in 2001.

Population estimates for the Trinity River population are not available. Limited presence/absence data are available from the U.S. Forest Service. A weir at Willow Creek provides some information for adult coho migrating upstream (Table 2-2). Given the decline of other populations for which quantitative run size data is available and human activities such as logging, mining, and fishing impacts have similarly occurred; coho salmon abundance in most tributary streams is probably much less than it was historically. It is likely that the naturally produced adult population of the Trinity River in any given year is less than 2,000, which is below the low risk spawner threshold.

Table 2-2. Coho salmon run size estimates for the Trinity River based on counts at the Willow Creek weir (CDFG 2008). Note: Naturally produced coho salmon may return to the Trinity River later than their hatchery counterparts, and after the weir at Willow Creek is removed from the river.

Year	Dates	Location	Catch	Hatchery proportion of catch	Estimated Run Size
2003	09/17 to 11/18	Willow Creek	250	86	28,152
2004	09/10 to 11/25	Willow Creek	1,009	77	38,882
2005	09/03 to 11/04	Willow Creek	772	92	31,419
2005	09/24 to 12/02	Junction City	1,161	92	24,615

The population growth rate in Lower Trinity River basin has not been quantified. The long-term declines that are assumed to have taken place in the Lower Trinity River wild coho salmon population suggest negative population growth rate. The low natural population abundance and negative population growth mean that it does not meet the minimum standards of a viable salmonid population.

2.2.3.2 Population Productivity

The productivity of a population (*i.e.*, the number of individuals generated over a specified time interval) can reflect conditions (*e.g.*, environmental conditions) that influence the dynamics of a population and determine abundance. In turn, the productivity of a population allows an understanding of the performance of a population across the landscape and habitats in which it exists and its response to those habitats (McElhany *et al.* 2000). Status reviews for the SONCC coho salmon ESU, the CC Chinook salmon ESU, and the NC steelhead DPS concluded data were insufficient to set specific numeric population productivity targets for viability (Spence *et al.* 2007, Williams *et al.* 2011). McElhany *et al.* (2000) suggested a population's natural productivity should be sufficient to maintain its abundance above the viable level. This guideline seems a reasonable goal in the absence of numeric abundance targets.

2.2.3.2.1 ***NC Steelhead***

As described in the *Species and Critical Habitat Description and Status* sections, populations of NC steelhead have declined substantially from historic levels. Spence et al. (2008) concluded that adult abundance information for steelhead in this DPS were insufficient to rigorously evaluate the viability of the 42 independent populations of winter-run steelhead using criteria developed by the TRT. Fish counts at Van Arsdale Fish Station in the Upper Eel River basin represent the longest time series data of abundance for adult steelhead in 19 this DPS. Fish are collected from three separate populations upstream: Bucknell Creek, Soda Creek located in the Lower Interior stratum, and the upper main stem Eel River located in the North Mountain Interior stratum. The TRT concluded that populations in Bucknell Creek and Soda Creek are at moderate to high risk of extinction based on low adult counts at Van Arsdale Fish Station and prevalence of hatchery fish (i.e., >90%) counted from 1997-2007. Bucknell Creek and Soda Creek were originally included as focus populations in Spence et al. 2008; however, NMFS removed these creeks from the list in the CIE draft Multi-species Recovery Plan because of natural barriers in both creeks that block fish passage. The Upper Eel River population was deemed to be at high risk of extinction due to the loss of the majority of historical habitat above Scott Dam and the high proportion of hatchery fish returning to Van Arsdale. Short time series data of adult population abundance from Pudding Creek, Noyo River, Caspar Creek, and Hare Creek on the Mendocino Coast suggest that all four populations could potentially be considered at moderate risk of extinction if population abundances remain relatively constant over time (Spence et al. 2008). All other winter-run populations were deemed data deficient.

The Middle Fork Eel River, which has been monitored since the mid-1960s, has the longest and most comprehensive fish abundance time series data for summer-run steelhead. Fish counts have averaged 780 fish over the period of record and 609 fish in the last 16 years. Both the short-term (16-year) and long-term (44-year) show negative trends over time but the trends are not significant ($p = 0.507$ and $p = 0.424$, respectively). Reports on the annual summer steelhead abundance surveys have been published by the Mattole Salmon Group on the Mattole River from 1996 to 2007; annual summer counts have been conducted the last four years since the release of the latest report. Because survey efforts vary among years, the measure of the number of fish per km provides the best index of abundance. The use of this index suggest (for the Mattole River) marginally significant negative trends in the number of adults (slope = -0.013; $p = 0.072$) and a positive trend for half-pounders (slope = 0.044; $p = 0.093$) over the period of record (Williams et al. 2011). As productivity does not appear sufficient to maintain viable abundances in many NC steelhead populations, NMFS concludes this DPS is not viable in regards to the population productivity VSP parameter.

2.2.3.2.2 ***CC Chinook Salmon***

As described in the *Species and Critical Habitat Description and Status* sections, populations of CC Chinook salmon have declined substantially from historic levels. Currently, the lack of population-level estimates of abundance for Chinook salmon populations in this ESU continues to hinder assessment of its status. The available data, a mixture of partial population estimates and spawner/redd indices show somewhat mixed patterns, with some showing slight increases and others slight decreases, and few of the trends being statistically significant (Williams et al. 2011b). Further, it is difficult to interpret the available numbers in the context of population viability criteria developed by the TRT. For example, the only available time series from the Upper Eel River are from Tomki Creek and Van Arsdale Station, which together represent only a fraction of the total habitat available to Chinook salmon in this population. These data indicate a minimum combined spawner abundance averaging 469 individuals over the past 16 years. However, the Upper Eel River population is likely substantially larger. For example, in the 2009-2010 spawning season, spawner surveys were conducted on the mainstem Eel River from Dos Rios to Van Arsdale Station, as well as in Outlet 20 Creek and one of its major tributaries, Long Valley Creek. These surveys covered about 40% of the available spawning habitat in these reaches and resulted in a population estimate of just over 3,000 fish (Harris 2010). Adding to this number the Tomki Creek maximum live/dead count and the Van Arsdale Chinook count (534 fish) and the total exceeds 3,500 for those portions of the Upper Eel River that were surveyed this year, which does not include the Middle Fork Eel River, or the mainstem Eel River and its tributaries from Dos Rios downstream to the confluence of the South Fork of the Eel River. This example highlights the difficulty in interpreting index reach counts that cover only a small fraction of the available spawning habitat. Until more exhaustive and spatially representative surveys of the available habitat are done on a consistent basis, the status of Chinook salmon in these watersheds will remain highly uncertain.

At the ESU level, Williams et al. (2011b) expressed several areas of concern. Within the North Coastal and North Mountain Interior strata, all independent populations continue to persist, though there is high uncertainty about current abundance in all of these populations. The loss of the spring Chinook life-history type from these two strata represents a significant loss of diversity within the ESU. Additionally, the apparent extirpation of all populations south of the Mattole River to the Russian River (exclusive) means that one diversity stratum (North-Central Coastal) does not currently support any populations of Chinook salmon, and a second stratum (Central Coastal Stratum) contains only one extant population (Russian River) that, while it remains relatively abundant, has shown a declining trend since 2003. The significant gap in distribution diminishes connectivity among strata across the ESU.

Williams et al. (2011b) concluded it is difficult to characterize the status of this ESU based on the available data. Williams et al. (2011b) did not find evidence of a substantial change in conditions since the last status review (Good et al. 2005), but were concerned about the loss of representation from one diversity stratum, the loss of the spring-run life history type (two diversity substrata), and the diminished connectivity between populations in the northern and southern half of the ESU when viewed in the context of TRT's viability criteria for this ESU. Complicating the assessment is the fact that the historical occurrence of persistence populations in the region from Cape Mendocino to Point Arena, which includes the two southern-most diversity strata, is also highly uncertain (Bjorkstedt et al. 2005). As productivity does not appear sufficient to maintain viable abundances in many CC Chinook salmon populations, NMFS concludes this ESU is not viable in regards to the population productivity VSP parameter.

2.2.3.2.3 ***SONCC Coho Salmon***

As described in the *Species and Critical Habitat Description and Status* sections, populations of SONCC coho salmon have declined substantially from historic levels. The most recent status review (Williams et al. 2011a) describes that available time series have been downward and that the longest existing time series from the Shasta River exhibited significant negative trends since 2001, as did two extensive time series from the Rogue River Basin. For the 2011 status update, Williams et al. (2011a) describes that none of the time series examined (other than West Branch and East Fork Mill Creek), had a positive short-term trend and further examination of these time series data indicated that the strong 2001 brood year was followed by a decline across the entire ESU.

In addition, of concern to the viability of SONCC coho salmon is that recent favorable marine conditions in 2007 and 2008 did not result in improved marine survival resulting in increased adult returns. In 2008, adult spawner populations (fish resulting from the 2005 brood year) within the Oregon Coast coho salmon ESU rebounded from recent declines (Lewis et al. 2009), while escapement of many SONCC coho salmon populations, including those in the Rogue River, declined to near record low numbers (Williams et al. 2011a). However, despite the recent information from the Shasta River indicating increases in adult escapement in 2011, 2012, and 2013 (62, 115, and 151 adults respectively)—likely responding to a period of favorable ocean conditions—the total number of spawning adults remains below recovery levels. As productivity does not appear sufficient to maintain viable abundances in many SONCC coho salmon populations, NMFS concludes this ESU is not viable in regards to the population productivity VSP parameter.

2.2.3.3 Spatial Structure

Understanding the spatial structure of a population is important because the population structure can affect evolutionary processes and, therefore, alter the ability of a population to adapt to spatial or temporal changes in the species' environment (McElhany *et al*. 2000). Status reviews for the SONCC coho salmon ESU, the CC Chinook salmon ESU, and the NC steelhead DPS concluded data were insufficient to set specific population spatial structure targets (Spence *et al*. 2007, Williams *et al*. 2007). In the absence of such targets, McElhany *et al*. (2000) suggested the following: "As a default, historic spatial processes should be preserved because we assume that the historical population structure was sustainable but we do not know whether a novel spatial structure will be."

2.2.3.3.1 ***NC Steelhead***

Blockages to fish passage exist on two major rivers in the DPS and on numerous small tributaries (Good *et al.* 2005). These blockages degrade the spatial structure and connectivity of populations within the DPS. The Upper Eel River population was deemed to be at high risk of extinction due to the loss of the majority of historical habitat above Scott Dam and the high proportion of hatchery fish returning to Van Arsdale. Short time series data of adult population abundance from Pudding Creek, Noyo River, Caspar Creek, and Hare Creek on the Mendocino Coast suggest that all four populations could potentially be considered at moderate risk of extinction if population abundances remain relatively constant over time (Spence et al. 2008). All other winter-run populations were deemed data deficient. As the 'default' historic spatial processes described by McElhany *et al.* (2000) have likely not been preserved, NMFS concludes this DPS is not viable in regards to the spatial structure VSP parameter.

2.2.3.3.2 ***CC Chinook Salmon***

The distribution of Chinook salmon in this ESU continues to be curtailed or blocked by dams in the Eel and Russian River basins. As noted above, Peters Dam in the Lagunitas Creek watershed curtailed or blocked access to historic Chinook salmon spawning and rearing habitat (NMFS 1998); however, it was not part of the listed ESU because it is south of the current ESU boundary at the Russian River. New information on the presence of Chinook salmon in the Lagunitas Creek watershed and genetic data suggesting these fish are most likely part of the CC Chinook salmon ESU led to the SWFSC's recommendation that the southern boundary of this ESU be extended southward to include all coastal watersheds north of the Golden Gate, including Lagunitas Creek. If this boundary change is implemented through formal rulemaking, Peters Dam on Lagunitas Creek will be identified as further curtailing Chinook salmon habitat in this ESU (Williams et al. 2011b). NMFS concludes this ESU is not viable in regards to the spatial structure VSP parameter.

2.2.3.3.3 ***SONCC Coho Salmon***

Relatively low levels of observed presence in historically occupied coho salmon streams (32 to 56 percent from 1986 to 2000) indicate continued low abundance in the California portion of the SONCC coho salmon ESU. The relatively high occupancy rate of historical streams observed in broodyear 2001 suggests that much habitat remains accessible to coho salmon (June 28, 2005, 70 FR 37160). Brown *et al*. (1994) found survey information on 115 streams within the SONCC coho salmon ESU, of which 73 (64 percent) still supported coho salmon runs while 42 (36 percent) did not. The streams Brown *et al*. (1994) identified as presently lacking coho salmon runs were all tributaries of the Klamath River and Eel River systems. The BRT was also concerned about the loss of local populations in the Trinity, Klamath, and Rogue River basins (June 28, 2005, 70 FR 37160). CDFG (2002) reported a decline in SONCC coho salmon occupancy, with the percent reduction dependent on the data sets used. Although there is considerable year-to-year variation in estimated occupancy rates, it appears that there has been no dramatic change in the percent of coho salmon streams occupied from the late 1980s and early 1990s to 2000 (Good *et al*. 2005). In summary, recent information for SONCC coho salmon indicates that their distribution within the ESU has been reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which they are now absent (NMFS 2001). However, extant populations can still be found in all major river basins within the ESU (June 28, 2005, 70 FR 37160).

The most recent status review (Williams *et al.* 2011a) describes that available time series have been downward and that the longest existing time series from the Shasta River exhibited significant negative trends since 2001, as did two extensive time series from the Rogue River Basin. For the 2011 status update, Williams et al. (2011a) describes that none of the time series examined (other than West Branch and East Fork Mill Creek), had a positive short-term trend and further examination of these time series data indicated that the strong 2001 brood year was followed by a decline across the entire ESU.

In addition, of concern to the viability of SONCC coho salmon is that recent favorable marine conditions in 2007 and 2008 did not result in improved marine survival resulting in increased adult returns. In 2008, adult spawner populations (fish resulting from the 2005 brood year) within the Oregon Coast coho salmon ESU rebounded from recent declines (Lewis et al. 2009), while escapement of many SONCC coho salmon populations, including those in the Rogue River, declined to near record low numbers (Williams et al. 2011a). However, despite the recent information from the Shasta River indicating increases in adult escapement in 2011, 2012, and 2013 (62, 115, and 151 adults respectively)—likely responding to a period of favorable ocean conditions—the total number of spawning adults remains below recovery levels.As the 'default' historic spatial processes described by McElhany *et al.* (2000) have likely not been preserved, due to the habitat fragmentation described above, NMFS concludes this ESU is not viable in regards to the spatial structure VSP parameter.

The presence of juvenile coho salmon has been confirmed in many streams in the Lower Trinity River Basin including Manzanita Creek, Big French Creek, New River, East Fork New River, Willow Creek, Horse Linto Creek, Cedar Creek (Everest 2008, Boberg 2008). Most of these streams, however, do not have a substantial amount of high IP habitat (IP > 0.66). Coho salmon have also been found in Tish Tang, Supply, Campbell, Hostler, Mill Creeks and in most years since the early 1990s in Willow Creek as far upstream as the Boise Creek confluence. Horse Linto and Cedar creeks have most of the available coho habitat on the Trinity River side of the Six Rivers National Forest and coho have been found every year in these two creeks. Based on this current distribution of coho salmon in the Lower Trinity, most of the historic habitat of the Lower Trinity River remains accessible to coho salmon.

2.2.3.4 Diversity

Diversity, both genetic and behavioral, is critical to success in a changing environment. Salmonids express variation in a suite of traits, such as anadromy, morphology, fecundity, run timing, spawn timing, juvenile behavior, age at smolting, age at maturity, egg size, developmental rate, ocean distribution patterns, male and female spawning behavior, and physiology and molecular genetic characteristics. The more diverse these traits (or the more these traits are not restricted), the more diverse a population is, and the more likely that individuals, and therefore the species, would survive and reproduce in the face of environmental variation (McElhany *et al.* 2000). However, when this diversity is reduced due to loss of entire life history strategies (*e.g*., loss of summer-run NC steelhead and spring-run CC Chinook salmon), or to loss of habitat used by fish exhibiting variation in life history traits, the species is in all probability less able to survive and reproduce given environmental variation.

Negative effects to genetic diversity can result from hatchery production and stocking of hatchery-bred fish into wild streams. Hatchery-reared fish may be less genetically diverse than wild fish due to artificial selection, and may have originated in areas with different environmental conditions. Once in the hatchery, artificial selection for fish which survive well in the hatchery is likely to occur (Allendorf and Ryman 1987). If the hatchery-bred fish later interbreed with wild fish, they can reduce the genetic diversity of the wild population. Even if the overall genetic diversity of the wild population is unchanged, the introduction of non-native or less diverse genetic material into a native salmonid population can "dilute" the native population's adaptation to its local environment and make it less able to survive and reproduce (McElhany *et al.* 2000).

Genetic variability of wild stocks is naturally altered by straying from natural populations in nearby streams, which results in gene flow and often sustains or even increases the genetic diversity of a population over time. Straying is a normal and important part of the life history and evolution of Pacific salmon (Quinn 2005), but human activities can increase the rate of straying and cause more genetic interaction between populations than would naturally occur. Founding hatchery populations with broodstock from outside the watershed can make straying more common, as seen in the Columbia River (Pascual *et al*. 1995). Therefore, the genetic makeup of hatchery steelhead from the Mad River could detrimentally affect steelhead in many other rivers within and even outside the geographic range of the NC steelhead DPS. Excessive straying can also be detrimental to wild fish populations born in their natal streams. When habitat becomes degraded, or inaccessible due to dams or road crossings, salmonid spatial distribution can become fragmented. In this situation, straying into non-natal streams is likely to increase when salmonids are denied access to their natal areas and are forced to enter other streams that are accessible. Increased stray rates would be expected to reduce population viability, particularly if the strays are accessing unsuitable habitat or are mating with genetically unrelated individuals (McElhany *et al*. 2000).

Status reviews for the SONCC coho salmon ESU, the CC Chinook salmon ESU, and the NC steelhead DPS concluded data were insufficient to set specific numeric diversity targets (Spence *et al.* 2007, Williams *et al.* 2011a. McElhany *et al.* (2000) suggested the following in the absence of specific targets for diversity: "Historically, salmonid populations were generally self-sustaining, and the historical representation of phenotypic diversity serves as a useful 'default' goal in maintaining viable populations."

2.2.3.4.1 ***NC Steelhead***

Millions of steelhead from outside the Mad River or outside the DPS have been stocked into rivers in the NC steelhead DPS many times since the 1970s. Bjorkstedt *et al.* (2005) documented 39 separate releases of this kind, and many of these releases occurred over multiple years. Of particular concern is the practice of rearing Eel River-derived steelhead in a hatchery on the Mad River before restocking them into the Eel River (Bjorkstedt *et al.* 2005). Over ten years, more than one-half million yearlings were reared and released in this way. This practice may have reduced the effectiveness of adult homing to the Eel River (Bjorkstedt *et al.* 2005). In addition, the abundance of summer-run steelhead was considered "very low" in 1996 (Good *et al.* 2005), indicating an important part of the life history diversity in this DPS may be at risk.

Summer-run populations are sampled more regularly as these adult fish can be quantified more easily than winter-run population during summer months because they can be counted in holding pools. The largest summer run population in the DPS spawns in the Middle Fork Eel River and has been surveyed annually since the 1960s. This population was deemed at moderate risk of extinction due to the fact that although population numbers continued to be slightly above low-risk thresholds (*i.e*., established by the TRT), there continued be a long-term declines in summer run populations. The TRT concluded that the Mad River summer-run population was likely to be at moderate risk of extinction. Two other summer-run populations, Redwood Creek and Mattole River, were deemed to be at high risk of extinction based on very low adult counts (Spence et al. 2008). NMFS concludes the current behavioral diversity in this ESU is much reduced compared to historic levels, so by McElhany's criteria, it is not viable in regards to the diversity VSP parameter. In addition, the genetic integrity of the DPS may have been compromised by hatchery introductions.

2.2.3.4.2 ***CC Chinook Salmon***

As of 2005, Bjorkstedt *et al.* concluded "most recent and ongoing artificial propagation efforts in the CC Chinook ESU are small in scale and restricted to supplementing depressed populations with progeny of local broodstock (2005)." The low hatchery production observed in the ESU is less likely to mask trends in ESU population structure and pose risks to ESU diversity than if hatchery production were higher, making hatchery production less of a concern for this ESU than others. Williams *et al.* (2011) in a NMFS Status Review said the NMFS Biological Review Team (BRT) had concerns with respect to diversity that were based largely on the loss of spring-run Chinook salmon in the Eel River basin. Additionally, the BRT was very concerned about the paucity of information and resultant uncertainty associated with estimates of abundance, natural productivity, and distribution of Chinook salmon in this ESU.

Experts consulted during the previous status review gave this ESU a mean risk score of 3.1 (out of 5) for the diversity VSP category (Good *et al.* 2005). This score indicates the ESU's current genetic variability and variation in life history factors contribute significantly to long-term risk of extinction but do not, in themselves, constitute a danger of extinction in the near future. Low genetic diversity is therefore not considered the most important factor to this ESU's viability. However, Spence *et al.* (2007) expressed concern over the loss of spring-run populations in this ESU. NMFS concludes the current behavioral diversity in this ESU is much reduced compared to historic levels, so by McElhany's criteria it is not viable in regards to the diversity VSP parameter.

2.2.3.4.3 ***SONCC Coho Salmon***

Genetic variability is important because differing genetic traits favor a population being able to survive and reproduce under changing environmental conditions. With regard to the SONCC coho salmon ESU, human activities (including construction of migration barriers, *e.g*., Iron Gate Dam on the Klamath River and Lewiston Dam on the Trinity River) have eliminated portions of some coho salmon populations from the ESU. In addition, runs of coho salmon within the Klamath River basin are now composed largely of hatchery fish from Iron Gate and Trinity River Hatcheries.

The high hatchery production in some systems in the SONCC coho salmon ESU may mask trends in ESU population structure and pose risks to ESU diversity (June 28, 2005, 70 FR 37160). NMFS determined that the Cole Rivers Hatchery, Trinity River Hatchery, and Iron Gate Hatchery coho salmon hatchery programs are part of the ESU, and that these artificially propagated stocks are no more divergent relative to the local natural populations than what would be expected between closely related natural populations within the ESU (June 28, 2005, 70 FR 37160). Within the 10 historical populations that have dams, 26.4 percent of historical habitat is currently located upstream of the dams (Table 5 in Williams *et al*. 2007). Loss of or limiting spawning and rearing opportunities are expected to adversely affect the species' basic demographic and evolutionary processes, causing a reduced potential that the ESU can withstand environmental fluctuations. Activities that affect evolutionary processes (*e.g*., natural selection) have the potential to alter the diversity of the species.

Although not well documented, there appears to be some diversity of life history strategies in the lower Trinity River. For example, both young-of-the-year and one year old coho salmon are captured at downstream migrant traps located in the Trinity River near Willow Creek (Pinnix *et al.* 2007). This may indicate that juvenile coho salmon in the Trinity River rear in natal and/or non-natal streams prior to emigrating to the ocean.

In terms of overall diversity, interactions with hatchery fish play a major role in the health of the population. Each year, Trinity River Hatchery releases approximately 500,000 coho salmon smolts. Currently, coho salmon returns to the Trinity River are dominated by hatchery fish (TRFE 1999, Table 2-7). From 2003 to 2005, over 75 percent of adults returning to the Trinity River - as estimated at Willow Creek - were of hatchery origin (Table 2-2). A population is at least at a moderate risk of extinction if the fraction of hatchery fish spawning in the wild exceeds five percent (Williams *et al.* 2007). Trinity River hatchery coho salmon stray into many of the tributaries on the Six Rivers National Forest, such as Horse Linto Creek. Straying of hatchery fish into tributaries of the Trinity River presents a particular threat to the diversity viability parameter, as hatchery fish may reduce the reproductive success of the overall population (Mclean *et al* 2003) through outbreeding depression (Reisenbichler and Rubin 1999). Because of the high numbers of adult hatchery coho salmon migrating through the lower Trinity River, and because they are known to stray into non-natal tributaries, the Lower Trinity River population of coho salmon is at a high risk of extinction with regards to the Diversity parameter.

The primary factors affecting the diversity of SONCC coho salmon appear to be the influence of hatcheries and out-of-basin introductions. In addition, some brood years have abnormally low abundance levels or may even be absent in some areas (*e.g.,* Shasta River and Scott River), further restricting the diversity present in the ESU. Experts consulted during the previous status review gave this ESU a mean risk score of 2.8 (out of 5) for the diversity VSP category (Good *et al.* 2005). This score indicates the ESU's current genetic variability and variation in life history factors contribute significantly to long-term risk of extinction but do not, in themselves, constitute a danger of extinction in the near future. NMFS concludes the current phenotypic diversity in this ESU is much reduced compared to historic levels, so by McElhany's criteria it is not viable in regards to the diversity VSP parameter.

2.2.3.5 Summary

2.2.3.5.1 ***NC Steelhead***

Based on the above descriptions of the population viability parameters, and qualitative viability criteria presented in Spence *et al.* (2007), NMFS believes that the NC steelhead DPS is currently not viable and is at an elevated risk of extinction.

2.2.3.5.2 ***CC Chinook Salmon***

Based on the above descriptions of the population viability parameters, and qualitative viability criteria presented in Spence *et al.* (2007), NMFS believes that the CC Chinook salmon ESU is currently not viable and is at a moderate to high risk of extinction.

2.2.3.5.3 ***SONCC Coho Salmon***

Based on the above descriptions of the population viability parameters, qualitative viability criteria presented in Williams *et al*. (2007), and the target spawner numbers for population viability listed in the SONCC Coho Recovery Plan, NMFS believes that the SONCC coho salmon ESU is currently not viable and is at high risk of extinction.

2.2.4 <u>Status of Critical Habitat</u>

This Opinion analyzes the effects of the Project on critical habitat for SONCC coho salmon (May 5, 1999, 64 FR 24049), CC Chinook salmon (September 2, 2005, 70 FR 52488), and NC steelhead (September 2, 2005, 70 FR 52488).

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.

This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete the following analysis with respect to critical habitat.

The ESA 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.

NC Steelhead and CC Chinook Salmon

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

Critical habitat for NC steelhead was designated as occupied watersheds from the Redwood Creek watershed, south to and including the Gualala River watershed. Critical habitat for CC Chinook salmon was designated as occupied watersheds from the Redwood Creek watershed, south to and including the Russian River watershed (70 FR 52488). Humboldt Bay and the Eel River estuary are designated as critical habitat for both the NC steelhead DPS and CC Chinook salmon ESU. Some areas within the geographic range were excluded due to economic considerations or because they overlap with Indian lands (Table 2-2).

Table 2-2. Watersheds excluded, in whole or part, from critical habitat designation for NC steelhead DPS and/or CC Chinook salmon (70 FR 52488).

NC Steelhead DPS	
Watershed Name	**Area Excluded**
Ruth	Entire watershed
Spy Rock	Tribal land
North Fork Eel River	Entire watershed; Tribal lands
Lake Pillsbury	Entire watershed
Eden Valley	Indian lands
Round Valley	Indian lands

CC Chinook Salmon ESU	
Watershed Name	**Area Excluded**
Bridgeville	Entire watershed
Spy Rock	Indian lands
North Fork Eel River	Indian lands
Eden Valley	Tributaries only; Indian lands
Round Valley	Indian lands
Black Butte River	Entire watershed
Wilderness	Entire watershed
Navarro River	Entire watershed
Santa Rosa	Entire watershed
Mark West	Entire watershed

Designated critical habitat for NC steelhead and CC Chinook salmon overlaps the project action area. In designating critical habitat for NC steelhead and CC Chinook salmon, NMFS focused on the known physical and biological features (PBFs) essential for the conservation of each species. PBFs are those sites and habitat components that support one or more life stages, including: (1) freshwater spawning, (2) freshwater rearing, (3) freshwater migration, (4) estuarine areas, (5) nearshore marine areas, and (6) offshore marine areas. Within the PBFs, essential elements of CC Chinook salmon and NC steelhead critical habitats include adequate (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, (10) safe passage conditions, and (11) salinity conditions (September 2, 2005, 70 FR 52488).

SONCC Coho Salmon

Critical habitat for the SONCC coho salmon ESU encompasses accessible reaches of all rivers (including estuarine areas and tributaries) between Cape Blanco, Oregon and Punta Gorda, California (May 5, 1999; 64 FR 24049). Excluded are: (1) areas above specific dams identified in the FR notice, (2) areas above longstanding natural impassible barriers (*i.e*., natural waterfalls in existence for at least several hundred years), and (3) tribal lands.

Designated critical habitat for SONCC coho salmon overlaps the project action area except for the HVT's proposed action. Critical habitat for SONCC coho salmon does not occur on the HVIR. In designating critical habitat for SONCC coho salmon, NMFS focused on the known physical and biological features (PBFs) within the designated area that are essential to the conservation of the species. These essential features may include, but are not limited to, spawning sites, food resources, water quality and quantity, and riparian vegetation. Within the essential habitat types (spawning, rearing, migration corridors), essential features of coho salmon critical habitat include adequate (1) substrate, (2) water quality, (3) water quantity, (4) water temperature, (5) water velocity, (6) cover/shelter, (7) food, (8) riparian vegetation, (9) space, and (10) safe passage conditions (May 5, 1999, 64 FR 24049). The current condition of critical habitat for SONCC coho salmon is discussed in the factors affecting the species below.

2.2.4.2 Conservation Value of Critical Habitat

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

Watershed restoration activities have improved freshwater critical habitat conditions in some areas, especially on Federal lands. The five northern California counties affected by the Federal listing of coho salmon (which includes Humboldt County) have created a 5 County Conservation Plan that will establish continuity among the counties for managing anadromous fish stocks (Voight and Waldvogel 2002). The plan identifies priorities for monitoring, assessment, and habitat restoration projects. In addition, the SONCC Coho Recovery Plan prioritizes the key limiting stressors and threats for each population segment, prioritizes recovery actions for each population segment, and lists the key recovery efforts to being made for each population (NMFS 2014).

Although watershed restoration activities have improved freshwater critical habitat conditions in isolated areas, reduced habitat complexity, poor water quality, and reduced habitat availability as a result of continuing land management practices continue to persist in many locations.

2.2.4.3 Current Condition of Critical Habitat

As part of the critical habitat designation process, NMFS convened Critical Habitat Analytical Review Teams (CHARTs) for steelhead and Chinook salmon. These CHARTs determined the conservation value of Hydrologic Subareas (HSAs) of watersheds under consideration. A CHART was not convened for SONCC coho salmon, because critical habitat had already been designated in 1999. NMFS determined the condition of SONCC coho salmon critical habitat based on other, readily available information.

2.2.4.3.1 ***NC Steelhead***

For NC steelhead, the CHART identified 50 occupied HSAs within the freshwater and estuarine range of the DPS, eight of which occur within the proposed action area. Nine HSAs were rated low in conservation value, 14 were rated medium, and 27 were rated high in conservation value (NMFS 2005). Within the DPS, the CHART ratings and economic benefits analysis resulted in designation of critical habitat with essential features for spawning, rearing and migration in approximately 3,148 miles of occupied stream habitat. NMFS believes the status of NC steelhead critical habitat in the 50 HSAs has not changed substantially since the 2005 assessment.

2.2.4.3.2 ***CC Chinook Salmon***

NMFS' assessment of the current condition of critical habitat for the CC Chinook salmon ESU shows PCE's for spawning and rearing habitat in the two major rivers within this ESU, the Eel and Russian Rivers, to be severely degraded by the persistence of highly turbid flows during the winter and spring, persisting even at low flows. The persistence is considered to be primarily a result of flows released from Scott Dam and Coyote Valley Dam (Ritter and Brown 1971, USACE 1982, Beach 1996). Migration and rearing habitat PCEs in the Eel River (both riverine and estuarine) are degraded by diminished flows resulting from water storage in Lake Pillsbury (Scott Dam) and by interbasin diversions to the Russian River through the Potter Valley Project tunnel. Rearing habitat PCEs of the Russian River, both riverine and estuarine, are considered to be degraded as a result of land use patterns changing the channel configuration limiting available habitat, and a program of keeping the Russian River estuary breached throughout the year. Within the smaller coastal streams of the ESU, the status of critical habitat PCEs for rearing, spawning, and migration are considered degraded to a lesser extent.

For CC Chinook salmon, the CHART identified 45 occupied HSAs within the freshwater and estuarine range of the ESU, eight of which occur within the proposed action area. Eight HSAs were rated low in conservation value, 14 were rated medium, and 27 were rated high in conservation value (NMFS 2005). Within the ESU, CHART ratings and economic benefits analysis resulted in the designation of critical habitat with essential features for spawning, rearing and migration in approximately 1634 miles of occupied habitat. NMFS believes the status of CC Chinook salmon critical habitat in the 45 HSAs has not changed substantially since the 2005 assessment.

2.2.4.3.3 ***SONCC Coho Salmon***

The condition of SONCC coho salmon critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined that present depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat: logging, agricultural and mining activities, urbanization, stream channelization, dams, wetland loss, and water withdrawals for irrigation. All of these factors were identified when SONCC coho salmon were listed as threatened under the ESA, revisited upon the development of the SONCC Coho Recovery Plan, and continue to affect this ESU. However, efforts to improve SONCC coho salmon critical habitat have been widespread and are expected to benefit the ESU. Within the SONCC recovery domain, since 2005, the following improvements were completed: 661 stream miles have been opened for fish passage by removing 440 barriers (NMFS 2014). In addition, from 2000-2006, 31 stream miles of instream habitat were stabilized, 41 cubic feet per second of water has been returned for instream flow; and 1000s of acres of upland, riparian, and wetland habitat have been treated (NMFS 2007). Therefore, the condition of SONCC coho salmon critical habitat is likely improved or trending toward improvement compared to when it was designated in 1999.

Critical habitat is not designated on the HVIR, therefore, this discussion is specific to The Trinity River sites included in the LOP. Habitat within the action area is used by coho salmon primarily as a migration corridor for adults moving upstream to spawn in tributary streams. Data on the occurrence of mainstem spawning are limited due to poor water visibility during the spawning period. Juvenile coho salmon use the project area primarily for outmigration to the ocean in the spring and early summer. It is unlikely that coho salmon regularly rear in project reaches during the extraction period due to lack of preferred habitat and warm summer water temperatures (Zedonis 2003); although some juvenile coho summer rearing cannot be ruled out (D. Halligan, Stillwater Sciences, personal observation).

Coho salmon have been documented spawning and outmigrating in Willow Creek (USFS 2003). In addition, they have been documented in Horse Linto Creek (approximately 5 miles downstream of the extraction area) and Sharber Creek (several miles upstream of the McKnight site). Since known spawning tributaries are near the extraction sites, some juvenile coho salmon likely use the mainstem for rearing during cooler periods. Coho juveniles likely utilize low-velocity areas within extraction reaches as refuge during high winter flows, and for rearing leading up to outmigration. Mainstem juvenile rearing in the Trinity River is thought to occur primarily in the upper mainstem upstream of the North Fork (USFWS 1999).

2.2.4.4 Summary of Current Conditions

Although watershed restoration activities have improved freshwater critical habitat conditions in isolated areas, reduced habitat complexity, poor water quality, and reduced habitat availability as a result of continuing land management practices continue to persist in many locations and are likely limiting the conservation value of designated critical habitat within these freshwater habitats at the ESU scale.

2.3 Environmental Baseline

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). The environmental baseline provides a reference condition to which we add the effects of the Project, as required by regulation ("effects of the action" in 50 CFR § 402.02). The evaluation in the *Environmental Baseline* of the current extinction risk for the populations of each listed species within the action area, and the condition of critical habitat for each population provides a reference condition at the population scale to which NMFS will later add the effects of the proposed action in the *Integration and Synthesis* section to determine if the action is expected to affect the population's risk of extinction. The effects of all past and present impacts individual listed fish, or the essential features of critical habitat, are carried forward through the anticipated period of impact (POI). The POI for this consultation is 10 years (the term of the proposed action) plus any subsequent period that encapsulates the time until anticipated impacts dissipate. These conditions form the context under which the expected effects of the proposed action are added.

The discussion below first describes current and historic impacts to salmonids and salmonid habitat across the action area as a whole. Then, the general setting and factors unique to each river reach in the action area are discussed. This discussion includes a description of habitat condition, salmonid trends, abundance and utilization of each reach. **Table 2-**3 shows which populations of ESA-listed salmonids are found within each river reach.

Table 2-3. Exposure, by population and river reach. The “x” does not include the egg life stage.

ESU/DPS	Population	River Reach								
							Isolated Sites			
		Trinity River	Lower Eel River	Van Duzen River	Middle Eel River	South Fork Eel River	Ft. Seward (M. Eel R.)	PL Bar (V. Duzen R.)	Bear River	Mattole River
SONCC Coho Salmon	Lower Trinity River	X	~	~	~	~	~	~	~	~
	South Fork Trinity River	O	~	~	~	~	~	~	~	~
	Upper Trinity River	O	~	~	~	~	~	~	~	~
	Lower Eel/VanDuzen River	~	X	X	~	~	~	X	~	~
	Middle Mainstem Eel River	~	O	~	X	~	X	~	~	~
	Mainstem Eel River	~	O	~	X	~	X	~	~	~
	Middle Fork Eel River	~	O	~	O	~	O	~	~	~
	South Fork Eel River	~	O	~	O	X	O	~	~	~
	North Fork Eel River	~	O	~	O	~	O	~	~	~
	Upper Mainstem Eel River	~	O	~	O	~	O	~	~	~
	Bear River	~	~	~	~	~	~	~	X	~
	Mattole River	~	~	~	~	~	~	~	~	X
CC Chinook Salmon	Lower Eel River	~	X	X	X	~	X	X	~	~
	Upper Eel River	~	O	~	O	X	O	~	~	~
	Bear River	~	~	~	~	~	~	~	X	~
	Mattole River	~	~	~	~	~	~	~	~	X
NC Steelhead Summer-Run	Eel River (mainstem)	~	X	~	X	X	X	~	~	~
	Van Duzen R.	~	O	X	~	~	~	X	~	~
	Larabee Creek (Eel R.)	~	O	~	O	~	O	~	~	~
	Middle Fork (Eel R.)	~	O	~	X	~	X	~	~	~
	South Fork Eel R.	~	O	~	O	X	O	~	~	~
	Upper Mid. Main. (Eel R.)	~	O	~	O	~	O	~	~	~
	Upper Mainstem (Eel R.)	~	O	~	O	~	O	~	~	~
	North Fork (Eel R.)	~	O	~	O	~	O	~	~	~
	Mattole River	~	~	~	~	~	~	~	~	X
NC Steelhead Winter-Run	Van Duzen (Eel R.)	~	O	X	~	~	~	X	~	~
	North Fork Eel (Eel R.)	~	O	~	O	~	O	~	~	~
	South Fork Eel R.	~	O	~	O	X	O	~	~	~
	Middle Fork Eel R.	~	O	~	O	~	O	~	~	~
	Upper Mainstem Eel R.	~	O	~	O	~	O	~	~	~
	Kekawaka Creek (Eel R.)	~	O	~	O	~	O	~	~	~
	Dobbyn Creek (Eel R.)	~	O	~	O	~	O	~	~	~
	Chamise Creek (Eel R.)	~	O	~	O	~	O	~	~	~
	Price Creek (Eel R.)	~	O	~	X	O	X	~	~	~
	Howe Creek (Eel R.)	~	O	~	X	O	X	~	~	~
	Jewett Creek (Eel R.)	~	O	~	O	~	O	~	~	~
	Pipe Creek (Eel R.)	~	O	~	O	~	O	~	~	~
	Bell Springs Creek (Eel R.)	~	O	~	O	~	O	~	~	~
	Woodman Creek (Eel R.)	~	O	~	O	~	O	~	~	~
	Outlet Creek (Eel R.)	~	O	~	O	~	O	~	~	~
	Tomki Creek (Eel R.)	~	O	~	O	~	O	~	~	~
	Bucknell Creek (Eel R.)	~	O	~	O	~	O	~	~	~
	Soda Creek (Eel R.)	~	O	~	O	~	O	~	~	~
	Bear River	~	~	~	~	~	~	~	X	~
	Mattole River	~	~	~	~	~	~	~	~	X
"O" denotes YOY, juvenile, and adult exposed; "X" denotes all life stages exposed in the action area.										

Finally, 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.

2.3.1 Historic and Current Impacts to Salmonids across the Action Area

2.3.1.1 Artificial Propagation (Hatcheries)

There are two salmonid production facilities in operation within or upstream of the action area; the Iron Gate Hatchery (Klamath River) and the Trinity River Hatchery (Trinity River). The Trinity River hatchery has been adversely impacting salmonids in the Trinity River and Lower Klamath River. The potential adverse impacts of artificial propagation programs are well documented (reviewed in Waples 1991, National Research Council 1995, Natural Resource Council 1996, Waples 1999). These potential impacts have three broad categories: disease, genetic, and ecological. Hatchery origin salmonids may stray into the Eel, Van Duzen, and Mattole Rivers but likely comprise less than five percent of the total salmonid population (NMFS 2014). Four hatcheries once operated in the Eel River basin but have since ceased operations therefore they will not be considered in the environmental baseline.

2.3.1.1.1 ***Trinity and Klamath River Hatcheries***

Two fish hatcheries impact the action area: Trinity River Hatchery (TRH) near the town of Lewiston and Iron Gate Hatchery (IGH) on the mainstem Klamath River near Hornbrook, California. Both hatcheries mitigate for anadromous fish habitat lost as a result of the construction of dams on the mainstem Klamath and Trinity Rivers, and production focuses on Chinook salmon, coho salmon, and steelhead. TRH releases about 4.3 million Chinook salmon, 0.5 million coho salmon and 0.8 million steelhead annually. IGH releases about 6.0 million Chinook salmon, 75,000 coho salmon and 200,000 steelhead; for a total of roughly 11,875,000 hatchery salmonids released into the Klamath Basin annually. Both hatcheries have affected the habitat and fish in the Lower Klamath population unit of coho salmon. In addition, these hatcheries have affected wild coho salmon migrating through the Lower Klamath unit area to and from the South Fork Trinity population unit, the Lower Trinity River population unit, and the Upper Trinity Population. TRH fish have also affected habitat in the Upper Trinity and Lower Trinity River population unit areas.

Genetic Impacts

For more than 30 years, concerns have been raised regarding the genetic effects of hatcheries on wild Pacific salmon and steelhead populations (HSRG 2009). Straying of hatchery fish, and interbreeding between fish of hatchery and wild origin, can result in loss of fitness in natural populations (HSRG 2009). More recently, it was shown that just one generation of hatchery rearing can hamper survival of wild-born offspring of hatchery origin fish (Araki 2009). Heath et al. (2003) opined that hatchery-reared coho salmon likely produce eggs that are smaller than those that may have had less hatchery influence, and these smaller eggs are less likely than larger eggs to survive outside of the hatchery. Hatchery-reared rainbow trout were found to have smaller brains, probably because they lost the need to survive in the more complex wild environment (Marchetti and Nevitt 2003). Their offspring may be expected to be less successful in the wild environment than wild-born fish, because the former are genetically acclimated to the simpler hatchery environment.

Ecological Impacts

Hatchery operations may have a suppressive effect on coho salmon through predation and competition, and it should not be assumed that hatchery operations are beneficial to salmonids or to coho salmon in particular (NRC 2004). When released into freshwater, hatchery fish may compete with naturally produced fish for food and habitat (McMichael et al. 1997, Fleming et al. 2000, Kostow et al. 2003, Kostow and Zhou 2006). Competition of hatchery fish with naturally produced fish almost always has the potential to displace wild fish from portions of their habitat (Flagg et al. 2000). Predation on wild salmonids by hatchery-reared salmonids has been observed (e.g., Naman 2008). The NRC (2004) recommended reducing the number of fish released at TRH and IGH in order to gain a better understanding of the extent to which hatchery fish impact natural production.

Trinity River Hatchery

TRH first began releasing coho salmon in 1960. Although substantial efforts were made to trap and haul coho salmon upstream of the construction area of Lewiston Dam, adult returns fell to essentially zero (zero females, seven males, nine grilse) during the 1962 to 1963 run. Inter-basin transfer of coho salmon eggs to the TRH often occurred, and upon release from the hatchery these coho salmon juveniles were likely not as well adapted to the Trinity basin's habitat conditions as were local stocks. The TRH facility originally used Trinity River coho salmon for broodstock, though coho salmon from Eel River (1965), Cascade River (1966, 1967, and 1969), Alsea River (1970), and Noyo River (1970) have also been reared and released at the hatchery as well as elsewhere in the Trinity River basin. Hatchery releases of coho salmon averaged about 500,000 from 1987 to 1991, decreased to about 400,000 from 1992 to 1996, then increased again to about 500,000 fish from 1997 to 2002. From 1991 to 2001, on average, 3,814 adult coho salmon were trapped and 562 females were spawned at TRH. In comparison to the other coho salmon hatcheries in the SONCC coho salmon ESU, the TRH coho salmon production goal is more than twice as great as the Cole Rivers Hatchery (200,000 annually) and more than six times as great as IGH (75,000 annually).

Coho salmon from the TRH are considered part of the SONCC coho salmon ESU, since out-of-basin and out-of-ESU transfers ceased by 1970, and production since that time has been exclusively from fish within the basin. The lack of natural production within the Trinity Basin, however, remains a significant concern. The TRH spawning protocol currently incorporates approximately 20 percent unmarked adults into the spawning matrix, i.e., 20 percent of pairings are crosses of hatchery and wild origin fish.

Hatchery-origin coho salmon make up most of the spawning run to the Trinity River each year. On average, only three percent of in-river spawners were not reared in a hatchery (USFWS and HVT 1999). Between 1997 and 2002, hatchery fish constituted between 85 percent and 97 percent of the fish (adults plus grilse) returning to the Willow Creek weir in the Lower Trinity River (Table 2-4, Sinnen 2009).

Table 2-4. Estimates of run size of coho salmon at the Trinity River's Willow Creek weir, 1997-2008. Hatchery-origin fish were identified by a mark (right maxillary clip). From Sinnen (2009).

Year	Number Unmarked	Number Marked	% Hatchery	% Natural
1997	651	7,284	92	8
1998	1,232	11,348	90	10
1999	586	4,959	89	11
2000	539	14,993	97	3
2001	3,373	28,768	90	10
2002	596	15,420	96	4
2003	4,093	24,059	86	14
2004	9,055	29,827	77	23
2005	2,740	28,679	92	8
2006	1,624	18,454	92	8
2007	1,199	4,551	79	21
2008	1,312	8,671	87	13

Straying of hatchery-born coho salmon into non-natal tributaries in the Lower Trinity River basin is known to occur, but the stray rates have not been quantified (Cyr, personal communication, 2008). Nickelson (2003) found that wild coho salmon abundance decreased as the number of salmonid smolts released from nearby hatcheries increased. A recent study found that steelhead released from TRH suppress wild coho salmon populations via predation (Naman 2008).

To limit the genetic risks of hatcheries, and meet conservation goals, the Hatchery Scientific Review Group (HSRG 2009) developed quantitative standards for the proportion of in-river spawning hatchery fish (pHOS), the proportion of hatchery broodstock derived from natural-origin fish (pNOB), and the proportion of natural influence (PNI) to be used in a hatchery. The PNI measures gene flow between hatchery origin and natural origin fish, and is calculated by determining the proportion of natural origin fish in the hatchery brood stock (PNOB) and dividing this by the proportion of natural spawners in the stream comprised of hatchery origin fish (pHOS) plus the percent natural origin fish (PNOB) in the hatchery brood stock (HSRG 2009). The influence of natural spawners increases and PNI increases as the proportion of natural origin fish spawning in the wild, and being used as hatchery brood stock, increases (HSRG 2009). Therefore, a successful hatchery program would have few hatchery fish straying into the spawning grounds and many natural fish available for use as hatchery broodstock (HSRG 2009). The SONCC coho salmon recovery plan (NMFS 2014) states the PNI must be $\geq$ 0.7, and the pHOS must be < 0.05, for the SONCC coho salmon ESU to be at an acceptable risk from hatchery impacts. Table 2-5 shows the PNI and PHOS from 1997 to 2008 at the TRH. The median PHOS is 0.825, far greater than the desired 0.30, and the median PNI is 0.045, more than an order of magnitude lower than the desired value of 0.67. Currently, spawners of natural origin are making very little genetic contribution to hatchery stock, and the amount of natural influence in the hatchery population is extremely low.

Table 2-5. Gene flow between natural-origin and hatchery-origin coho salmon at TRH from 1997 to 2008, as determined by calculating the proportion of hatchery origin spawners (PHOS), proportion of natural origin broodstock (PNOB), and proportion of natural influence (PNI). Adult return data provided by W. Sinnen, CDFG.

Run Year	Unmarked spawned at hatchery	Marked spawned at hatchery	Total unmarked on spawning grounds	Total marked on spawning grounds	PHOS	PNOB	PNI
1997	16	738	632	5,520	0.90	0.02	0.02
1998	43	1,375	1,189	6,480	0.84	0.03	0.03
1999	50	1,124	524	1,477	0.74	0.04	0.05
2000	11	926	528	10,670	0.95	0.01	0.01
2001	13	1,036	3,360	18,119	0.84	0.01	0.01
2002	32	2,084	564	8,323	0.94	0.02	0.02
2003	186	2,184	3,907	12,880	0.77	0.08	0.09
2004	74	1,167	8,981	19,884	0.69	0.06	0.08
2005	97	1,640	2,643	11,233	0.81	0.06	0.06
2006	77	1,991	1,547	8,128	0.84	0.04	0.04
2007	90	1,276	1,109	1,845	0.62	0.07	0.10
2008	82	1,119	1,230	3,851	0.76	0.07	0.08

2.3.1.2 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. Effects have been a decrease in the overall quality and complexity of habitat, such as filling of pools, erosion of riparian vegetation, and export of in-stream woody debris. 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 the action area, legacy effects that likely persist are widened and aggraded channels due to the quantity of sediment that was deposited in the reach during the floods.

2.3.1.3 Timber Harvest

On non-Federal timberlands, commercial timber harvest is regulated by the California Forest Practice Rules. Environmental impacts identified with timber harvest include erosion from road construction and logging, resulting in increased sediment production, and loss of streamside vegetation resulting in increased water temperatures. Timber harvest activities have altered watershed conditions by changing the quantity and size distribution of sediment, leading to stream channel instability, pool filling by coarse sediment, or introduction of fine sediment to spawning gravels. These conditions contribute to a reduction in overall habitat complexity within the action area, negatively impacting salmonid species.

On March 1, 1999, the USFWS and NMFS issued a joint section 10(a)(1)(B) Incidental Take Permit to Pacific Lumber Company, Scotia Pacific Company LLC and Humboldt Redwood Company (HRC), for their Habitat Conservation Plan (HCP). The Incidental Take Permit exempts take of a number of species, including CC Chinook Salmon, SONCC coho Salmon, and NC steelhead.

A portion of the action area for the HRC HCP is within the middle and lower sections of the Eel River basin, including the lower Van Duzen River, the Mattole River, and the Bear River. Included in the HRC HCP is an Aquatic Conservation Plan (ACP) to minimize, mitigate and monitor the effects of timber harvesting activities on aquatic ecosystems. The goal of the ACP is to maintain or achieve, over time, properly functioning aquatic habitat conditions, which are essential to the survival of salmonids. The six main elements of the ACP are: riparian management strategy, hillslope management, road management, watershed analysis, a disturbance index, and monitoring.

The HRC HCP focuses on moving towards properly functioning conditions over the 50 year term of the permit. However, there is no timeline established for achieving properly functioning conditions in watersheds covered by the HRC HCP. Therefore, some watersheds that have been significantly degraded to the extent that they currently do not support listed species (*e.g.*, tributaries of the Eel River) may not necessarily improve over the term of the HRC HCP to where they again support healthy fish populations.

Timber harvest has long been a major economic use in the action area watersheds, resulting in a long and continuing legacy of effects to salmonids. In the most recent designation of critical habitat (February 16, 2000, 65 FR 7764), NMFS noted that human activities in the riparian zone and upslope areas can harm stream function and salmonids, both directly and indirectly. These activities include timber harvests that can increase sediment inputs, destabilize banks, reduce organic litter and woody debris, and increase water temperatures. Collectively, these impacts have simplified stream habitat that salmonids depend on. This simplification of habitat has occurred through the filling of pools, the lack of LWD to create and maintain habitat and provide cover. Increased sediment loads resulting from timber harvests have also increased turbidity levels, impairing the ability of juvenile salmonids to feed. Where temperatures are sufficiently high, salmonids may avoid the reach entirely, or suffer from increased metabolic stress. Therefore, past timber harvest has reduced both the abundance and distribution of salmonids in the action area.

2.3.1.4 Road Construction

Road construction, whether associated with timber harvest or other activities, has caused widespread impacts to salmonids (Furniss *et al.* 1991). Improperly placed culverts have blocked fish access to many stream reaches. Landslides 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 sediment loads. Cederholm *et al.* (1981) reported that the percentage of fine sediments in spawning gravels increased above natural levels when more than two and one-half percent of a basin area was covered by roads.

Within the action area, this excessive sediment has contributed to decreased survival to emergence as spawning gravels are filled with fine sediments, reduced carrying capacity for juvenile salmonids due to pool filling, and reduced feeding and growth due to high turbidity levels.

2.3.1.5 Reservoirs and Flow Regulation

2.3.1.5.1 ***Potter Valley Flow Releases***

Water diversion within the Eel River basin has occurred for many years at the Potter Valley facilities. Cape Horn Dam, on the upper mainstem Eel River, was constructed in 1907 and included fish passage facilities. Soon after construction, CDFG recognized that the ladder design presented difficulties to migrating adult fish. In 1962 and 1987, major modifications were made to the ladder to improve passage of salmonids [Steiner Environmental Consulting (SEC) 1998]. Roughly 160,000 acre feet (219 cfs average) are diverted at Cape Horn Dam, through a screened diversion, to the Russian River Basin annually. Scott Dam, which is approximately 19 km (12 mi.) upstream of Cape Horn Dam, was constructed in 1921 without fish passage facilities. VTN Oregon, Inc. (1982) reported that prior to dam construction; 56 to 72 km (35 to 45 mi.) of spawning and rearing habitat existed above Scott Dam and supported 2,000 to 4,000 fall-run Chinook salmon and winter-run steelhead. The USDA-FS and U.S. Department of Interior - Bureau of Land Management (USDI-BLM 1995) estimate that 160 km (100 mi.) of potential anadromous salmonid habitat were blocked by the dam.

Flow releases from the Potter Valley facilities have reduced both the quantity of water in the mainstem Eel River, particularly during summer and fall low flow periods, as well as dampened the within-year and between-year flow variability that is representative of unimpaired flows. These conditions have restricted juvenile salmonid rearing habitat, impeded adult and late emigrating smolt migration, and provided ideal low-flow, warm water conditions for the predatory Sacramento pikeminnow (NFMS 2002a).

On November 26, 2002, NMFS issued a biological opinion that determined that continued operation of the Potter Valley Project in a manner similar to its historic operation would jeopardize the continued existence of the three listed salmonid ESUs. The biological opinion included a reasonable and prudent alternative (RPA) that results in flows that more closely resemble the natural hydrograph and are deemed necessary to avoid jeopardy. The hydrograph resulting from implementation of the RPA more closely resembles the natural hydrology of the upper Eel River Basin, which should improve habitat for listed salmonids. Of particular importance is the superior response to hydrologic events in the Upper Eel River Basin and the provision of summer flows that allow for more realistic within-year and between-year flow variability that is representative of the unimpaired flow patterns within the Eel River. These features should provide improved habitat conditions and better survival rates for several salmonid life history phases and thus avoid jeopardy to listed salmonid species.

The Potter Valley Project RPA should result in improved temperature conditions in the upper Eel River. However, salmonids will still encounter sub-optimal temperature conditions in tributaries unaffected by improved conditions below the Potter Valley Project. Sub-optimal temperatures caused by existing watershed conditions are likely to continue in the lower Eel River, which is less influenced by Potter Valley Project releases.

In the South Fork Eel River, Benbow Dam, located near Garberville, was constructed in 1937. California State Parks operates the facility from July through the last weekend in September as a seasonal recreational facility. The facility, which historically blocked passage to adult and juvenile salmonids during the summer operating season, was modified in 1977 to allow adult and juvenile anadromous salmonid fish passage (NMFS 2002b). Operational procedures for managing the seasonal lake have reduced the impacts to listed anadromous fish species.

2.3.1.5.2 ***Lewiston Dam and Trinity River Diversion***

The Bureau of Reclamation's Trinity River Diversion exports water to the Sacramento River from the Trinity River. The Trinity River Division diverts an average of 53 percent (670,393 AF) of the watershed runoff at Lewiston. Depletion and storage of natural flows have drastically altered natural hydrologic cycles in the Trinity River. Alteration of streamflows has resulted in juvenile salmonid mortality as a result of: migration delays from insufficient flows or habitat blockages, loss of sufficient habitat due to dewatering and blockage, stranding from rapid flow fluctuations, and increased juvenile mortality resulting from increased water temperatures. In addition to these factors, reduced flows increase deposition of fine sediments into spawning gravels, decrease recruitment of new spawning substrate (gravel), and foster encroachment of vegetation into spawning and rearing areas.

2.3.1.6 Historic and Current Salmon Fishery

NMFS is concerned with the potential mortality of salmonids as a result of catch and release angling that occurs in the action area during the fall. Despite restrictions on the retention of non-hatchery salmonids once they enter freshwater, a catch and release fishery for Chinook salmon remains popular; especially in the Eel River component of the action area (J. Froland, CDFG, personal communication, 2002; M. Gilroy, CDFG, personal communication 2002). No analysis of the effects of this fishery on salmonids 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 salmonids that survive to spawn once they enter freshwater.

On April 18, 2008, the California Fish and Game Commission voted unanimously to prohibit commercial and recreational fishing of Chinook salmon in California marine waters, which extend to three miles off the coast. A federal ban was also approved in April 2008, by the Pacific Fishery Management Council and NMFS, which applies to salmon fishing in waters from three to 200 miles off the coasts of California and Oregon. These salmon fishing prohibitions were made in response to the sharp declines in Sacramento River fall-run Chinook salmon. The State and Federal prohibitions were made again in 2009, but commercial and recreational fishing of Chinook salmon has since resumed under Pacific Fishery Management Council, NMFS, and California Fish and Game Commission oversight.

2.3.1.7 Rural and Urban Development

The Eel River watershed includes, for example, the communities of Fortuna, Garberville, and Rio Dell. The Trinity River watershed includes the communities of Weaverville, Lewiston, Willow Creek, Hoopa, and Burnt Ranch. Many of the impacts to listed salmonids and their critical habitat are caused by rural development and associated road construction and land clearing. Numerous county and private roads over fish-bearing streams are migration barriers that limit the amount of spawning and rearing habitat available to salmonids. Other channel changes include levees near the town of Fortuna, the Sandy Prairie levee and the Grizzly Bluff levee, and rock slope protection on some of the banks in the lower river. These levees have reduced the quality and quantity of freshwater habitat and estuary area for rearing salmonids.

2.3.1.8 Gravel Extraction

Gravel extraction has occurred throughout the action area. In reaches where multiple excavations occur, such as the lower Eel and lower Van Duzen rivers, 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 when the size and elevation of gravel bars decreases and the thalweg elevation increases. 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 (Simon and Hupp 1992), each of which tends to simplify stream habitats by changing the channel geomorphology with subsequent changes to stream hydraulics which create and maintain pools and riffles.

2.3.1.8.1 ***Lower Eel River***

In the lower Eel River extraction reach, an average of 236,555 cy/yr, 172,908 cy/yr, and 137,668 cy/yr was extracted from 1997 to 2003, from 2004 to 2008, and from 2009-2014 respectively. The primary method of gravel extraction has been bar skimming, but within the last ten years alternative methods such as trenching have also been used. Trenches in the lower Eel River, particularly at the Hauck and Leland Rock site, have been functioning as an important improvement in migratory habitat. The more recent years have seen lower flows and decreased replenishment, contributing to lower amounts of gravel extraction.

Previously, channel degradation was documented in the lower Eel River by comparing 1968 air photos and cross sections with those from 1998 (Corps 1999). Overall net degradation in this reach ranged from 0.5 to 3.2 feet with channel bottoms showing degradation of 1.3 to 7.5 feet at Fernbridge. However, the degree to which degradation was due to gravel mining versus channel recovery from the 1964 flood is unknown. Beginning in the early 1990s, the CHERT review and recommendation process required by Humboldt County reduced total mining volumes for the Eel River from historic levels, and provided a mechanism to reduce geomorphic impacts at the site scale. However, due to the lack of sediment budget information and without an estimate of sustained yield, mining volumes on the Eel River have only been limited by site-specific conditions, vested right, or by Humboldt County Conditional Use Permit (CUP) amounts (Klein *et al.* 2001).

More recently CHERT (2009) analyzed some of the cross-sections within the lower Eel River to assess channel conditions and trends. CHERT (2009) found that thalweg elevations generally decreased between 1997 and 2007 from Hauck Bar upstream to Sandy Prairie. Mean channel bed elevations experienced a modest increase, suggesting bar growth coincident with channel deepening when averaging the analysis results. In the most downstream portion of the lower Eel River extraction reach, thalweg elevations increased along with increases in mean bed elevations, suggesting channel bed aggradation in the area near Fernbridge. Channel scour and fill computations showed "mixed results along the lower Eel River, with alternating scour and fill through the eight mile reach" (CHERT 2009).

Numerous factors have shaped the habitat conditions in the lower Eel River extraction reach. The lack of woody debris, high fine sediment loads and lack of streamside vegetation in the mining reach have all created current habitat conditions. Past extraction has likely reduced the carrying capacity of the lower Eel River slightly by reducing available pool habitat, reducing high quality riffle areas, removing the coarser surface armor layer found on undisturbed bars, reducing streamside vegetation and by contributing to a wider and shallower channel condition. In the absence of repeated mining, we expect the gravel bars would be higher elevation with a lower thalweg, both of which contribute to deeper pools and narrower riffles, with a coarser surface gravel and cobble layer, more streamside vegetation and increased channel confinement over a range of flows. However, trenching has improved migratory habitat and trenching is expected to continue to provide improvements in adult migration, particularly for Chinook salmon.

2.3.1.8.2 ***Middle Eel River***

Throughout the last ten years (2004-2014), the Middle Eel River reach had only four years of gravel extraction. Three out of the four extractions have occurred in the last 5 years (2009-2014), averaging 21,378 cy/yr. In the previous twelve years (1997-2008), an average 62,024 cy/yr was extracted in the Middle Eel River reach. Bar skimming has been the primary method of gravel extraction in this reach. On the whole, CHERT (2009) found that channel changes in this reach were relatively subdued and consistent among sites, particularly when compared to the lower Eel River.

HRC completed a more in-depth cross sectional analysis in their 2009 BA. The most notable patterns appear to be the changes in the thalweg and mean bed elevation that occurred after 2003 (HRC 2009). These correlations are worthy of note because no gravel extraction occurred during 2004-06 and in 2008 in the middle Eel River. HRC (2015) concluded that, "Although the relative change in" thalweg and mean bed elevations "is small (approximately one foot), there is a fairly strong relationship between the average thalweg and bed elevations within the reach. When extraction volumes are near the maximum annual allowable, the thalweg elevation increases and the mean bed elevation decreases. Conversely, when no extraction occurs, there is a decrease in the thalweg elevation and an increase in the mean bed elevation. These results suggest that the bar surface is highest and the channel thalweg is deepest at low extraction volumes."

Past gravel extraction in the middle Eel River contributed to a shallower thalweg elevation and lower gravel bar surfaces, leading to less pronounced riffles and pools. In the absence of gravel extraction the middle Eel River has experienced lower thalweg elevation and higher bar elevations, leading to more pronounced pools and riffles. In the absence of mining of the next five years, we would expect the thalweg and bars to continue to change in elevation, leading to deeper pools, narrower riffles, a slightly coarser surface cobble layer, more streamside vegetation and localized improvements in channel confinement.

2.3.1.8.3 ***South Fork Eel River***

In the South Fork Eel River an average of 18,154 cy/yr was extracted between 2009 and 2014. This is considerably lower than the 44,218 cy/yr extracted between 2004 and 2008 and the average of 61,243 cy/yr that was extracted between 1997 and 2003. Bar skimming has been the primary method of gravel extraction. During the past five years, alternative methods, such as trenching and alcove extractions, have also been used. Specifically, trenching was recommended by CHERT at the Cook's Valley site to reduce wide channel and shallow riffle conditions, which had been aggravated and increased by repeated bar skimming. Similar to the middle Eel River reach, past mining has likely resulted in localized increases in the low-flow channel width. These areas of widening may delay adult migration and reduce the amount of high quality riffle habitat available to salmonids. However, no long-term information exists to indicate the degree to which this has happened.

The cross sectional channel changes at the South Fork Eel River gravel bars have been minor (CHERT 2009) with nearly all the change occurring at the Cooks Valley Bar in the upstream end of the South Fork Eel River extraction reach. The net thalweg and mean bed elevations from 1997-2007 decreased by one to four feet with nearly all the change occurring near cross section 11 at the Cooks Valley Bar. However the scour was less than 500 square feet for three of the four cross sections examined, and approximately 1,500 square feet at cross section 11 (CHERT 2009).

In the absence of gravel extraction we expect that the South Fork Eel River would have lower thalweg elevations and higher gravel bar elevations, contributing to deeper pools and narrower riffles, and a more confined channel at the Cook's Valley location. We would also expect a coarser surface armor layer and an increase in streamside vegetation.

2.3.1.8.4 ***Lower Van Duzen River***

In the Van Duzen River, an average of 59,322 cy/yr was extracted between 2009 and 2014. This shows a considerable decrease in the average extraction volume between 2004 and 2008, and from 1997 to 2003, which was and average of 114,312 and an average of 117,846 respectively. The estimate of mean annual recruitment (MAR) for the Van Duzen River is between 135,000 to 202,000 cy with an average value of 168,500 cy (Klein *et al.* 2001).

Bar skimming was the primary method of gravel extraction previous to the past five years. In the past, bar skimming contributed to stranding of adults at the mouth of the Van Duzen near the confluence with the Eel River. In response to braided channel conditions, reduced channel confinement, shallow riffle conditions and adult stranding and mortality all aggravated by bar skimming, alternative methods such as trenching and wetland pits have been utilized more recently. Trenches have been designed to enhance adult salmonid migration and holding areas.

Trenches at the mouth of the Van Duzen and upstream at the Bess site have been functioning as an important migratory habitat improvement, especially for Chinook salmon.

CHERT (2009) concluded that the Van Duzen cross section analysis exhibited mixed results. Thalweg elevations increased and decreased over time at many cross sections, but the net changes for 1997-2007 were generally increases in thalweg elevations at the upstream sites (Bess and Noble), and decreases at the downstream site (Leland Rock). Mean bed elevations mostly mirrored thalweg elevations, with decreases at the downstream (Leland Rock) site ranging from about 1 to four feet and increases up to four feet at the middle site (Noble). NMFS has found that the vertical relief in the lower one mile reach of the Van Duzen River is increasing and that the river channel is becoming more confined.

CHERT (2009) also concluded that the cross section analysis generally showed that channel changes were greatest on the Lower Eel and Van Duzen rivers, but that there was no consistent trend among sites in these extraction reaches outside of those seen in the lower one mile reach of the Van Duzen River.

Bar skimming in the lower Van Duzen River is expected to reduce channel confinement, leading to wider and shallower conditions, contributing to poor migratory habitat. However, trenching is expected to continue to improve adult migratory habitat, particularly for Chinook salmon. Continued riparian planting in the lower Van Duzen at the Noble and Bess sites is expected increase the amount of streamside vegetation and to provide increased bank stability.

2.3.1.8.5 ***Trinity River***

An average of 8,358 cy/yr was extracted from the Trinity River between 2009 and 2014 which is a significant decrease in extraction volumes compared to the 2004 through 2008 (41,283 cy/yr). The presence of bedrock control and the relatively small volume of sediment removal have moderated the effects of extraction on habitat for salmonids.

The extraction reach is mainly located near the towns of Willow Creek and Hoopa, downstream of the confluence with the South Fork Trinity River, which contributes sediment and reduces the overall changes in sediment supply caused by the upstream impoundment of the mainstem Trinity River at Lewiston. Although information on past mining is minimal, we think the relatively limited extraction activities, within this bedrock controlled reach, have not caused significant declines in the value and quantity of salmonid habitat in the extraction reach of the Trinity River. This is based largely on the assumption that past extraction rates have not approached the estimate of MAR to the reach. Lehre and Burcell (1993) estimated that from 200,000 to 400,000 cy/yr were delivered to the reach at Hoopa, with a most likely value of 225,000 cy/yr.

In the absence of gravel extraction we expect that the habitat in the Trinity River would be similar to current conditions, with a relatively confined channel, deep pools, narrow riffles and coarse surface armor on the higher elevation portions of the gravel bars.

2.3.1.8.6 ***Mattole River***

Gravel extraction has only occurred once in the Mattole River in the past 5 years at the Cook Bar. A total of 6,518 cu.yds. was extracted in 2009 NMFS is not aware of recent reductions in the quantity or quality of habitat from gravel mining at the Cook Bar, nor do we expect significant changes to habitat from future mining at any of the sites listed as "isolated" in the CHERT reports.

2.3.1.9 Sacramento Pikeminnow

The introduction of Sacramento pikeminnow into Lake Pillsbury, and subsequently into much of the mainstem Eel River and major tributaries, has increased the risk of predation that lowers overall salmonid productivity. The pikeminnow is now one of the most abundant fish in the watershed (Moyle *et al.* 2008). Since their introduction, the Sacramento pikeminnow have distributed below Cape Horn Dam and now range throughout the basin (SEC 1998). Geary *et al.* (1992) suggested that the effect of pikeminnow on steelhead and Chinook salmon in the Upper Eel River has been serious, and the effect on rearing steelhead is most pronounced for marginal steelhead habitat (due to warm temperatures) downstream of Cape Horn Dam. Moyle *et al.* (2008) believe that Sacramento pikeminnow are suppressing Chinook salmon populations in the Eel River by foraging on emigrating juveniles. Sacramento pikeminnow impact salmonids by direct predation, and in the case of rearing steelhead, by displacing steelhead from pool habitat (Brown and Moyle 1991). Sacramento pikeminnow impacts are exacerbated by summer thermal conditions and low flows that provide ideal conditions for Sacramento pikeminnow in the mainstem Eel River. Reese and Harvey (2002) have also shown that there are more incidences of interspecific competition between young Sacramento pikeminnow and steelhead in warmer water compared to cooler water in laboratory streams. Due to predation and competition, Sacramento pikeminnow have decreased the carrying capacity of juvenile steelhead in the mainstem Eel River (Moyle 2002). While it may be too late to eradicate pikeminnow from the watershed (Moyle 2002), suppression efforts will occur as part of the Potter Valley Project FERC license term and conditions. As the native fish assemblages in the Eel River adjust to the presence of Sacramento pikeminnow, we expect that salmonid abundance will remain reduced below historic levels in the face of the increased predatory pressures.

2.3.1.10 Placer Mining

The discovery of gold in California in the 1860s resulted in intensive mining throughout the northern portion of this region. The Klamath and Trinity River basins were actively mined, and suction dredging and placer mining continues to the present day. Lode mining for gold, copper and chromite continued as recently as 1987. Water was diverted and pumped for use in sluicing and hydraulic mining operations. Hydraulic mining for gold washed hillslopes down into streams, causing siltation and sedimentation of waterways, degradation of riparian habitats, and alteration of stream morphologies. The negative impacts of stream siltation on fish abundance were observed as early as the 1930s. Several streams impacted by mining operations and containing large volumes of silt seldom had large populations of salmon or trout (Smith 1939).

The specific effects of mining activities on aquatic ecosystems depend upon the extraction and processing techniques used and the degree of disturbance.

Since the 1970s, large-scale commercial mining operations have been eliminated due to stricter environmental regulations. However, smaller mining operations continue, including suction dredging, placer mining, gravel mining, and lode mining. These mining operations can adversely affect spawning gravels, result in increased poaching activity, decrease survival of fish eggs and juveniles, decrease benthic invertebrate abundance, adversely affect water quality, and impact stream banks and channels.

2.3.2 <u>Eel River Baseline</u>

2.3.2.1 General Setting and Location

The Eel River basin is located in northern California in Humboldt, Mendocino, and Lake Counties. The basin drains 9,400 sq. km (3,630 sq. mi.) with a mean annual discharge of 6.5 million acre feet. Flows are highly variable between seasons and years. The basin is divided into two climates, the Mediterranean climate with hot, dry summers and cool, wet winters in the upper and middle basin, and a coastal climate with cool, foggy summers and moderate, rainy winters in the lower basin. Flows near the mouth of the Eel River have ranged from 0.34 cubic meters per second (cms) to 21,297 cms (12 to 752,000 cfs) in the historic record. Flows are consistently and vastly different between wet and dry seasons. The headwaters of the Eel River at elevations near 2,134 m (7,000 ft) receive 178 cm (70 in) of precipitation per year [U.S. Geological Survey (USGS) 1969]. Snow pack in elevations over 5,000 ft persists through May and into June.

For the purposes of this Opinion, the discussion of the Eel River is divided into four reaches: the South Fork Eel River, Middle Eel River (above the confluence with the Van Duzen River), the lower Eel River (below the Van Duzen River confluence) and the lower Van Duzen River. The following sections provide more detailed information for the individual reaches.

2.3.2.1.1 ***Lower Eel River below the Van Duzen River Confluence***

The Lower Eel River reach extends from the mouth of the Van Duzen River approximately eight miles downstream to about one mile below Fernbridge. Mining has occurred primarily at 15 areas on six bar features in the Lower Eel River in recent years. Halligan (1997a) described the lower reach of the Eel River as an area contained within a 0.5-mile to several mile-wide river valley that extends from Singley Bar, below Fernbridge, upstream approximately 40 km (25 mi.). The lower Eel River, from Rio Dell downstream, continues to the estuary through an unconfined depositional reach to the ocean. This low lying alluvial reach is typified by agriculture, dairy farms, and urban development. During the summer, water temperatures are cooled by the air temperatures in the coastal fog belt. The gage at Scotia recorded an average of 127 to 152 cm (50 to 60 in) of rain per year (USGS 1969). Upland habitats are typically comprised of dense redwood forests. Mainstem flows have ranged between 12 cfs during drought years and 750,000 cfs during extremely wet years in this reach. The valley is bordered by foothills of the coastal mountains.

2.3.2.1.2 *Middle Eel River above the Van Duzen River Confluence*

The Middle Eel River reach is approximately 30.7 miles total and begins about 5.7 miles upstream of the confluence with the South Fork Eel River, and extends downstream to the mouth of the Van Duzen River. There are 10 gravel bars that have been mined in the reach. Four of the mined bars are located in the 5.7 miles above the South Fork confluence. The lower five sites are located along the four-mile stretch of river above Scotia, approximately three miles below the Holmes-Larabee Bar.

2.3.2.1.3 *South Fork Eel River*

The South Fork Eel River is the second largest tributary to the Eel River, with a drainage basin of 1,784 sq. km (689 sq. mi., Halligan 1997a). The South Fork Eel River mining reach extends approximately 17.5 miles from Cook's Valley to Redway. The Wallan and Johnson Bar and Home/Tooby bars are the only bars proposed for extraction. The reach downstream of Legget Valley averages two percent gradient and is highly aggraded with assorted gravels (CDFG 1997). Mean annual precipitation in most of this watershed is between 152 and 178 cm (60 and 70 in). The upland areas are predominantly old growth redwood stands and previously logged mixed redwood-conifer-hardwood forest. The river is bordered by California State Park, Highway 101, Highway 254, small communities, and private timber land. The area of gravel extraction extends from near the town of Redway upstream to the Mendocino County line at Cook's Valley. This reach tends to be somewhat confined and subject to bedrock control in some areas (Halligan 1997b). For example, the Randall Sand and Gravel operation in Garberville excavates sediment that has been deposited on top of a bedrock shelf.

2.3.2.1.4 *Van Duzen River*

The Van Duzen River, a tributary to the Eel River, drains 1,100 sq. km (429 sq. mi., Halligan 1997a) and enters the Eel River approximately 22 km (14 mi.) from its mouth at the Pacific Ocean. Headwaters of the Van Duzen River watershed originate at over 1,520 m (5,000 ft) elevation in the northern California Coast Ranges, and the river is 15 m (50 ft) in elevation at the confluence of the Eel River. The geology of the Van Duzen River watershed is comprised of Franciscan, Yager, and tertiary and quaternary sediments. The climate is typical of northern California, Mediterranean with cool wet winters to warm dry summers. Annual precipitation ranges from 127 cm (50 in) near the confluence with the Eel River to 178 cm (70 in) at the headwaters. Flows within the Van Duzen River watershed vary considerably, with 75 percent of the rainfall occurring between November and April. August through September stream flows are less than 1.5 percent of the total. Bankfull discharge is 17,700 cfs at Bridgeville, with peak discharges of 48,700 cfs in 1964 and 34,600 cfs in 1974. Bankfull discharge is 37,400 cfs at its confluence with the Eel River, with peak discharges of 74,300 cfs in January 1995 and 57,000 cfs in March 1995 (Halligan 1997a). Agriculture (*e.g.*, ranching), timber harvest and gravel extraction are the primary land uses in the watershed, as described above in the discussion of general impacts within Humboldt County.

The Van Duzen River mining reach extends from the mouth of the Van Duzen River upstream about 5 miles to near Yager Creek. Mining has occurred from nine areas in the Van Duzen

River. Five mining sites are proposed in the LOP 2015-1 for the Van Duzen River: Leland Rock, Jack Noble River Ranch, Bess, and Pacific Lumber Bar.

2.3.2.1.5 *Lower Eel River*

Historic land and water management practices, as described generally for Humboldt County, contributed to loss of habitat diversity within the lower mainstem Eel River.
Cooling trends in downstream water temperatures continue to provide habitat for listed salmonids in the Lower Eel River. Cool water seeps, thermal stratification, and habitat complexity all play important roles in sustaining micro-habitat for juvenile and adult salmonids. Fishery data indicate depressed or declining abundance trends, yet observational data indicates natural populations persist in the Eel River, albeit at low levels. The degraded condition of the estuary, coupled with the marginal habitat conditions in the rest of the Eel River because of elevated temperatures, high sediment loads, paucity of woody debris, and presence of Sacramento pikeminnow highlight the sensitive setting of the lower Eel River for salmonids, especially Chinook salmon and steelhead.

The lower Eel River is listed in California's 2006 (EPA 2007) 303(d) list for sediment and temperature, under the Clean Water Act. The total maximum daily loads (TMDL) report was developed in 2007. EPA (2007) summarized stream temperatures and to what extent they reflected natural conditions, as opposed to temperatures that have been influenced by land management activities. All temperatures recorded in the mainstem Eel River were rated as stressful for salmonids. Additional temperature data was collected using an airborne Thermal Infrared Remote Sensing (TIR) study of the main channel during the summer of 2005 (Watershed Sciences, Inc. 2005). The result of that monitoring for the lower Eel River showed from the South Fork Eel (RM 40) to the estuary, most of the mainstem Eel River from mouth of the South Fork Eel River (RM 40) to the estuary was 23 to 24ºC, which is just below the acute lethal temperature (EPA 2007). EPA (2007) summarized that no temperature TMDL was needed for the lower mainstem Eel River because water quality standards for temperature are not being violated. The temperature analysis indicates that while current summer temperatures may be slightly higher than historical conditions, even the historical summer temperatures were so warm (in the lethal range for salmonids) that returning temperatures to historical conditions would not significantly improve conditions for salmonids in the lower mainstem Eel River.

The lower Eel River portion of the action area serves as an important holding area and migration corridor for salmonids. Therefore, conditions encountered along this reach, particularly during low-water periods, influence salmonid populations in the entire Eel River basin. We expect that CC Chinook salmon are most sensitive to conditions in this reach because they are known to enter the lower river in late summer and early fall when high water temperatures and low stream flows create stressful conditions for adults prior to upstream migration. Since the Eel River is one of the largest river systems in the range of the salmonids ESUs considered in this Opinion, conditions that influence basin-wide populations will have a measurable effect at the ESU level as well.

Habitat in this area has been characterized as being more homogeneous and simplified in comparison to other Humboldt County extraction reaches (Halligan 1996). Beginning in 2005 habitat data was collected in the lower Eel River, describing geomorphic characteristics (pool, riffle, flatwater) as well as habitat types specific to fish usage (holding, spawning, 2+ steelhead, alcoves). The combined pool:riffle:flatwater ratios for the extraction has remained relatively consistent between 2010 and 2013. Below, Figure 2-3 and Table 2-10 describe the habitat units 2005 through 2008; however, not enough long term data exists to establish trends.

Figure 2-3. Lower Eel River pool:riffle:flatwater percentages for 2005–2014, from the mouth of the Van Duzen River to Fernbridge (Stillwater Sciences 2015).

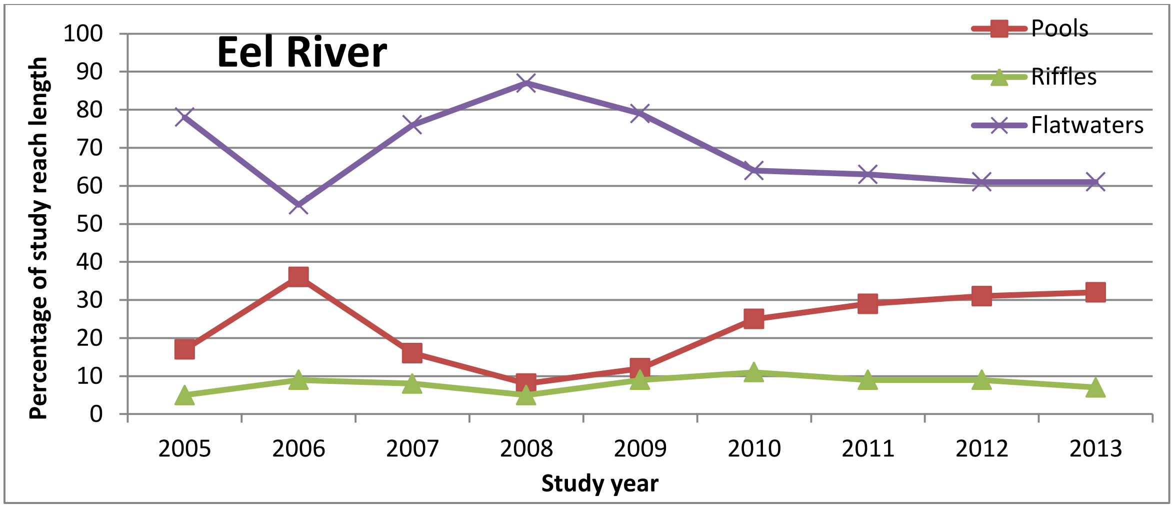

Table 2-10. Lower Eel River mapped habitat unit areas for 2005–2013, from the mouth of the Van Duzen River to Fernbridge (Stillwater Sciences 2015).

Operator/Bar	2005	2006	2007	2008	2009	2010	2011	2012	2013
					Adult holding (ft^2)				
ERM/Hauck	65,106	128,971	39,521	3,965	64,837	154,100	64,587	180,148	93,265
M-F/Sandy Prairie	331,762	1,076,295	433,830	ns	191,344	222,587	353,764	583,178	346,463
ERM/Drake	100,080	375,000	0	ns	0	147,869	140,447	134,523	60,761
Humboldt Co./Worswick	15,120	0	0	ns	31,425	96,568	21,002	119,883	98,050
Hansen/Hansen	ns	ns	ns	ns	6,459	60,717	97,143	89,512	ns
Total	**512,068**	**1,580,266**	**473,351**	**3,965[1]**	**294,065**	**686,841**	**676,943**	**1,107,244**	**598,539**
					Spawning (ft^2)				
ERM/Hauck	8,464	0	0	4,682	7,004	3,246	0	0	23,623
M-F/Sandy Prairie	0	0	0	ns	0	0	0	0	0
ERM/Drake	0	0	0	ns	0	0	0	0	0
Humboldt Co./Worswick	0	0	0	ns	0	0	0	0	0
Hansen/Hansen	ns	ns	ns	ns	15,859	0	0	0	ns
Total	**8,464**	**0**	**0**	**4,682[1]**	**22,863**	**3,246**	**0**	**0**	**23,623**

Age 2+ steelhead habitat abundance (ft^2)									
ERM/Hauck	21,206	21,787	29,049	8,837	19,093	48,002	67,297	28,123	28,268
M-F/Sandy Prairie	0	72,448	52,854	ns	62,194	141,173	222,705	8,114	37,713
ERM/Drake	0	0	0	ns	0	28,462	25,057	0	8,355
Humboldt Co./Worswick	0	0	0	ns	16,113	84,936	37,263	27,512	17,871
Hansen/Hansen	ns	ns	ns	ns	4,081	31,884	22,255	9,104	ns
Total	**21,206**	**94,235**	**81,903**	**8,837**[1]	**101,481**	**334,457**	**374,577**	**72,858**	**92,208**
Coho (ft^2)									
ERM/Hauck	0	0	0	0	0	0	0	0	0
M-F/Sandy Prairie	0	0	0	ns	0	0	5,442	3,504	3,209
ERM/Drake	0	0	0	ns	0	0	731	0	0
Humboldt Co./Worswick	0	0	0	ns	0	0	0	0	0
Hansen/Hansen	ns	ns	ns	ns	0	0	0	0	ns
Total	**0**	**0**	**0**	**0**	**0**	**0**	**6,173**	**3,504**	**3,209**
Alcove (ft^2)									
ERM/Hauck	0	28,107	13,883	0	3,472	0	0	0	0
M-F/Sandy Prairie	44,578	23,292	77,534	ns	146,844	135,544	128,528	29,935	11,392
ERM/Drake	45,600	0	0	ns	0	0	44,254	0	0
Humboldt Co./Worswick	94,770	126,787	0	ns	122,875	10,531	0	0	9,176
Hansen/Hansen	ns	ns	ns	ns	0	0	196,883	291,592	ns
Total	**184,948**	**178,186**	**91,417**	**0**[1]	**273,191**	**145,675**	**369,665**	**317,527**	**20,568**[2]

ns = no survey was conducted

1 Total habitat areas for 2008 are based solely on data for the Hauck Bar, as it was the only bar surveyed that year.

2 The precipitous drop in alcove ft^2 was due to excluding Hansen Bar from 2013 habitat monitoring efforts.

The 2013 adult Chinook salmon holding, spawning, age 2+ steelhead, coho salmon rearing, and alcove habitat areas within the extraction reaches covered 598,539 ft^2, 23,623 ft^2, 92,208 ft^2, 3,209 ft^2, and 20,568 ft^2, respectively (Stillwater Sciences 2015). The amount of adult holding decreased significantly from that observed in 2012, but was in line with 2010 and 2011. Age 2+ steelhead habitat was similar to what was observed in 2012 (Table 2-10). The spawning habitat area was the highest ever recorded. The amount of coho rearing habitat area was the same as that observed in 2012, but high summer water temperatures and predation pressures reduce its occupancy potential. The amount of alcove habitat was greatly reduced owing to the exclusion of the Hansen Bar from the monitoring program, which historically contributed most of the alcove habitat area in the monitoring reach.

The Eel River estuary is an important habitat type for salmonids which is used by all fish during outmigration and adult migration to the spawning grounds. Juveniles may utilize the estuary through much of the year: juvenile Chinook salmon and steelhead have been observed in fall, winter, and spring months (Humboldt County 1992). The estuary has decreased in areal extent and volume substantially since 1880 due to significant diking (Figure 2-4). Slough and creek channels that once meandered throughout the delta are now confined by levees, sufficiently slowing flow to a point that many have become filled with sediment. Remnant slough channels are visible throughout the delta. It is generally accepted that the estuary and tidal prism has been reduced by over half of its original size.

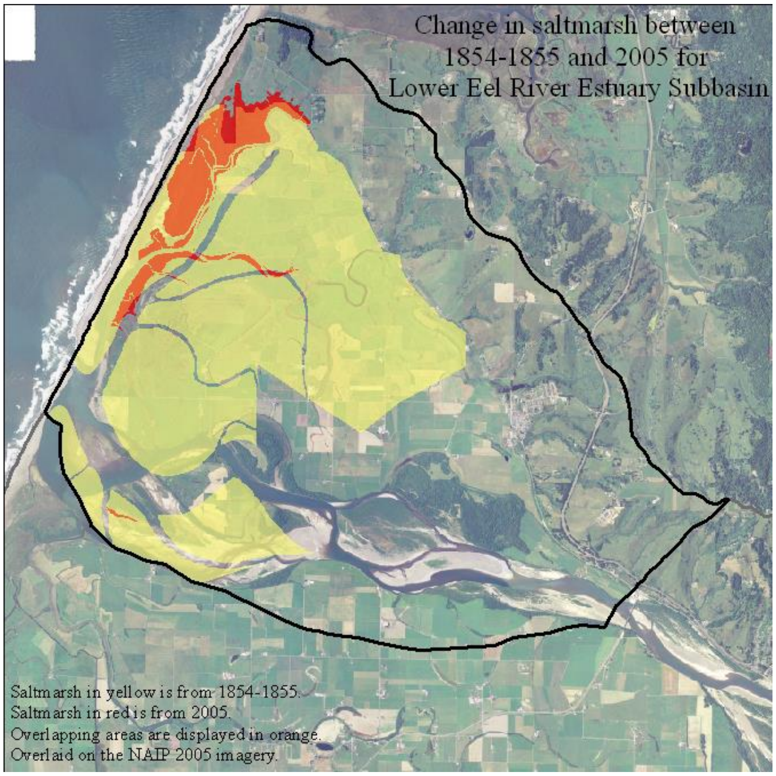

Figure 2-4. Change in salt marsh in the Eel River estuary between 1854 and 2005.

2.3.2.1.1 ***Middle Eel River above the Van Duzen River Confluence***

Historic land and water management practices have contributed to loss of habitat diversity within the middle Eel River above the Van Duzen River. Existing conditions indicate that the middle Eel River has limited rearing habitat due to elevated water temperatures, high sediment loads, paucity of woody debris, and competition/interaction with Sacramento pikeminnow. Cool water seeps, thermal stratification, and habitat complexity all play critical roles in sustaining micro-habitat for juvenile and adult salmonids. Spawning habitat is present, but its use has not been documented, except upstream near Van Arsdale. Fishery data indicate that individual natural populations of anadromous salmonids persist at low levels in the middle Eel River.

The middle Eel River portion of the action area serves as a migration corridor and juvenile rearing area for salmonids. In low-water years, the reach provides important Chinook salmon spawning habitat. For these reasons, conditions encountered along this reach, particularly during low-water periods, influence salmonid populations in the entire Eel River basin upstream of the Van Duzen River. We expect that CC Chinook salmon are most sensitive to conditions in this reach because they are known to enter the lower river in late summer and early fall when high water temperatures and low stream flows create stressful conditions for adults prior to upstream migration. Since the Eel River is one of the largest river systems in the ESUs considered in this

Opinion, conditions that influence basin-wide populations will have a measurable effect at the ESU level as well.

Gravel extraction volumes are greatest near the town of Scotia. The channel is moderately confined in the reach with large-scale roughness features such as bedrock bluffs and large alluvial flats providing a degree of stability to the location of individual habitat units. Persistence of salmonids in the reach is influenced by upstream flow releases, predation from Sacramento pikeminnow and activities which occur upslope in the watershed. Upstream activities and past floods have contributed to generally degraded habitat conditions along the middle Eel River. Pools are large, broad and shallow. Analysis of aerial photos presented by PALCO (2003) suggest that the river has been in a similar configuration since the 1940s. However, we caution that this inference is based on a limited set of historic photos and does not permit evaluation of more specific habitat indicators such as pool depths, substrate size and overall habitat complexity.

Very little recent salmonid habitat data are available for the Middle-Main section of the Eel River. Historical data collected at the Fort Seward extraction reach as required by LOP 2009-1 are summarized below. Caution should be taken when comparing pool, riffle, flatwater percentages from these habitat surveys, due to variation in surveyor methodologies. For more information on instream salmonid habitat in the South Fork Bar extraction reach, please refer to (HRC 2009 and 2015).

<u>Humboldt Redwood Company Bars</u>

Instream habitat for salmonids within the Middle Reach of the Eel River has been surveyed as part of the long-term monitoring program (HRC 2015). The total length of main channel surveyed each year is approximately 81,000 feet, including a side channel parallel to the main channel in the Holmes/Larabee, off-channel and "alcove" habitat. The ratio of pools, riffles and flat water was 39%:24%:37%.

The total area of the combined adult holding, spawning, juvenile rearing and alcove microhabitats is approximately 82 acres (5,628,537 ft_2). Area by microhabitat types is shown in Table 2-3. Of the four salmonid microhabitats identified, adult holding habitat is the most prevalent while spawning habitat has the least amount of area. Total microhabitat area varied significantly from year to year, probably reflecting both a difference in streamflow and a variance in the microhabitat typing. Similar surveys were conducted in earlier years, but we were unable to compare data due to differences in observers and methods. Differences in photo timing also make comparisons from year to year difficult. However, the same types of microhabitats have been observed at each bar since this type of monitoring began in 2002 (*i.e*., PALCO 2003).

Table 2-3. Summary of Microhabitat Area from 2007 to 2014

	Adult Holding		Juvenile 2+		Alcove		Spawning		Total Stream Microhabitat Area		
Year	# units	Area (ft²)	# units	Area (ft²)	# units	Area (ft²)	# units	Area (ft²)	Total Stream Area (ft²)	Total Stream Area (acres)	# units
2007	34	5,003,303	10	495,908	11	1,182,476	21	1,615,786	8,297,473	190	76
2008	50	3,904,947	12	267,945	14	685,125	33	771,740	5,629,757	129	109
2009	36	1,724,212	5	52,735	15	593,490	3	24,971	2,395,408	55	59
2010	35	1,653,202	4	72,689	11	570,794	2	25,889	2,322,574	53	52
2011	34	1,611,566	4	72,689	15	495,791	2	25,889	2,205,935	51	55
2012	34	2,502,605	19	687,485	15	558,596	1	57,000	3,805,689	87	69
2013	34	2,534,893	19	727,385	14	335,313	1	95,119	3,692,709	85	68
2014	30	2,544,532	8	429,263	13	419,028	4	190,458	3,573,282	82	55

2.3.2.1.2 ***South Fork Eel River***

Historic land and water management practices have contributed to loss of habitat diversity within the South Fork Eel River. The South Fork Eel River reach provides habitat for all three salmonid species considered in this Opinion. Specifically, the reach provides habitat for all life stages of the three salmonid species. Existing conditions indicate that the South Fork Eel River has limited rearing habitat due to elevated water temperatures. Cool water seeps, thermal stratification, and habitat complexity all play critical roles in sustaining micro-habitat for juvenile and adult salmonids. Spawning habitat is present and actively used, as indicated by observations of redds at the Cook's Valley site. Fishery data indicate that individual natural populations of anadromous salmonids persist, at low levels, in the South Fork Eel River.

Habitat typing of gravel extraction reaches on the South Fork Eel River was first conducted in 1997, when a total of 7,370 ft of the mainstem and an additional 1,100 ft of side channels within the M-F Cooks Valley and Randall extraction reaches were surveyed (Halligan 1998). Flatwaters, riffles, and pools comprised 47, 11, and 42 percent of the stream length, respectively. It must be noted that the 1997 method lumped pools with their associated glides as a single pool if they shared the same riffle crest. This led to a higher pool percentage than later monitoring efforts. The pool shelter rating in 1997 was low at 35, where CDFG considers a high rating to be 80 to 100. Instream shelter was made up of bedrock ledges, boulders, overhanging terrestrial vegetation, and bubble curtains. Mean and maximum pool depths averaged 2.25 and 8.5 ft, respectively. Substrate embeddedness averaged 40 percent. The side channel habitat consisted of two backwater pools with cool water seeps and a run.

In 1999, a total of 15,015 ft of extraction monitoring reaches were typed (Jensen 2000). At this time, runs, riffles, and pools comprised 50, 26, and 24 percent of the stream length, respectively. Mean and maximum pool depths averaged 3.4 and 7.9 ft, respectively. Substrate embeddedness ranged from 25 to 50 percent. An additional 3,375 ft of side channel habitat was also identified.

From 2005–2014, post-extraction habitat measurements were conducted annually for all gravel extraction reaches on the South Fork Eel River approximately which totaled 17,500 ft of the mainstem (Table 2-4). Habitat types were delineated and measured, pool and riffle crest depths were collected, and life-stage-specific habitat areas were mapped and measured. In 2004, only pool depth measurements were taken at RS&G and W&J reaches.

Table 2-4. South Forth Eel River mapped habitat unit areas from 2005 through 2013 (Stillwater Sciences 2015).

Operator/Bar	2005	2006	2007	2008	2009	2010	2011	2012	2013
Adult holding (ft²)									
M-F/Cooks Valley	56,153	55,784	56,747	28,638	33,726	48,153	69,780	73,665	64,855
Randall/Randall	20,982	31,140	8,619	7,258	10,324	20,717	35,809	38,732	30,456
W&J/Wallan	11,602	16,646	6,053	9,361	4,664	ns	ns	ns	ns
Total	**88,737**	**103,570**	**71,420**	**45,256**	**48,713**	**68,870**	**105,589**	**112,397**	**95,312**
Spawning (ft²)									
M-F/Cooks Valley	22,056	54,178	14,187	8,211	22,336	46,168	25,273	10,259	34,226
Randall/Randall	14,880	67,320	18,242	24,903	17,577	26,383	46,589	27,337	20,743
W&J/Wallan	16,595	13,478	12,799	23,197	12,886	ns	ns	ns	ns
Total	**53,531**	**134,976**	**45,227**	**56,311**	**52,798**	**72,551**	**71,862**	**37,596**	**54,970**
Age 2+ steelhead habitat abundance (ft²)									
M-F/Cooks Valley	nd	6,724	5,413	10,665	14,237	21,069	36,812	18,656	18,692
Randall/Randall	nd	5,301	8,845	16,252	8,402	24,490	36,668	19,393	14,263
W&J/Wallan	nd	7,603	4,773	12,463	6,224	ns	ns	ns	ns
Total	nd	**19,628**	**19,031**	**39,380**	**28,863**	**45,559**	**73,480**	**38,049**	**32,954**
Coho habitat abundance (ft²)									
M-F/Cooks Valley	nd	0	0	0	0	0	2,019	6,788	0
Randall/Randall	nd	0	0	0	0	1,156	1,430	2,454	4,519
W&J/Wallan	nd	0	0	0	0	0	ns	ns	ns
Total	nd	**0**	**0**	**0**	**0**	**0**	**3,449**	**9,242**	**4,519**
Alcove (ft²)									
M-F/Cooks Valley	23,322	20,671	0	30,638	53,572	104,564	37,890	22,664	9,066
Randall/Randall	2,883	0	0	4,399	2,340	0	6,494	0	7,036
W&J/Wallan	0	0	0	616	0	ns	ns	ns	ns
Total	**26,205**	**20,671**	**0**	**35,653**	**55,911**	**104,564**	**44,384**	**22,664**	**16,102**

The combined pool:riffle:flatwater percentages for the extraction reaches remained fairly consistent between 2005 and 2014 (Figure 2-5), but the proportion of riffle habitat declined considerably between 2007 and 2008 The largely constant pool:riffle:flatwater frequencies was likely due to the bedrock-controlled nature of the river channel.

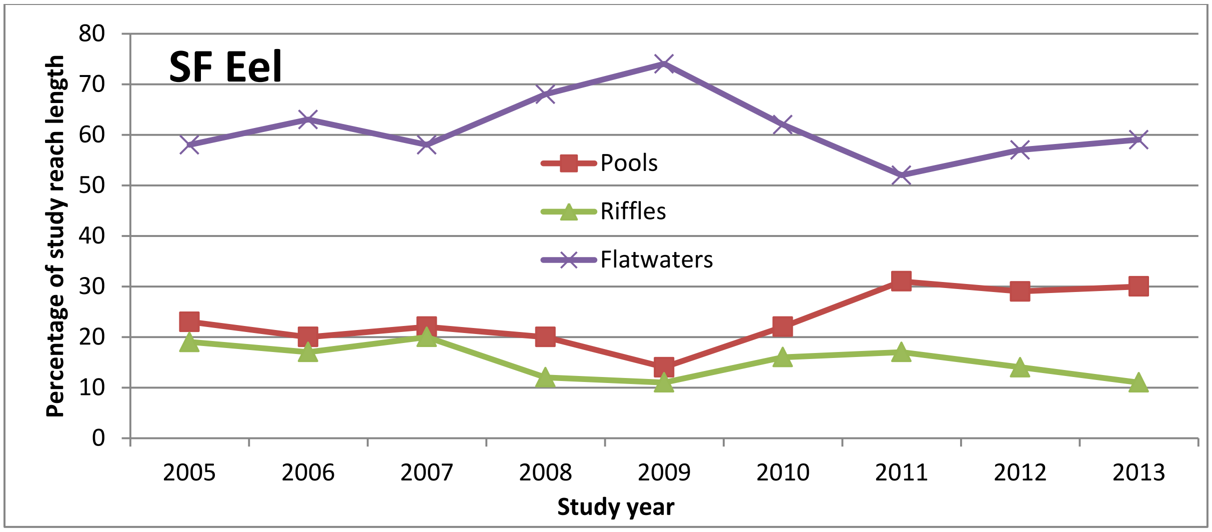

Figure 2-5. South Fork Eel River pool:riffle:flatwater percentages 2004–2013 (Stillwater Sciences 2014).

Trends in adult holding, spawning, age 2+ steelhead, and alcove habitat area for all South Fork Eel River extraction reaches combined from 2005 through 2014 are shown in Table 2-13. Each of these trends and their variation by extraction reach are detailed in the sections below. As noted in Stillwater Sciences (2008), there may be errors associated with habitat mapping due to varying discharges between dates when aerial photographs were flown and when the mapping was conducted.

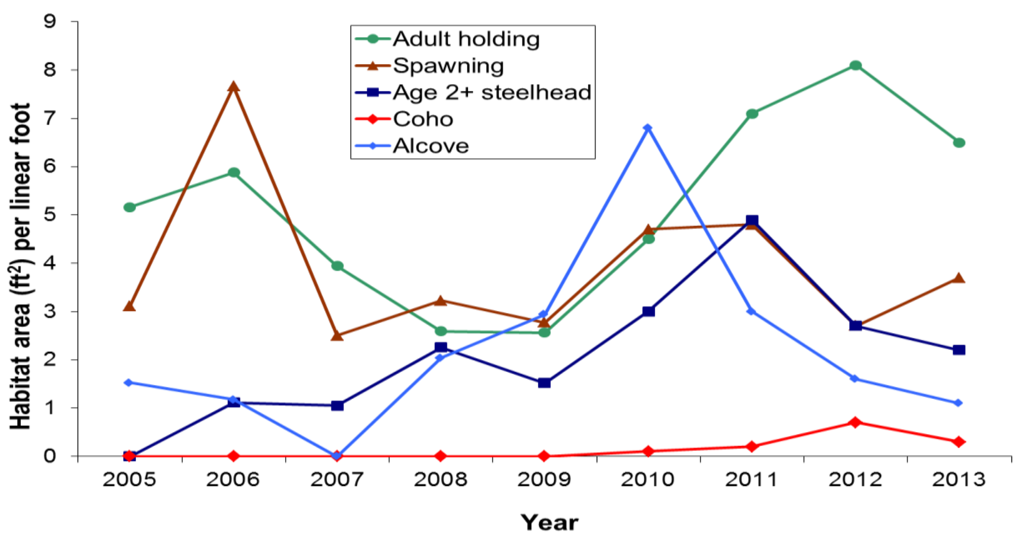

Figure 2-6. Total habitat area (ft^2) per stream-length surveyed (ft) for South Fork Eel River gravel extraction reaches (2005-2013) (Stillwater Sciences 2014).

The total habitat area per stream length surveyed on the South Fork Eel River varied significantly throughout the period of 2005 to 2013 (Figure 2-5). These fluctuations can be attributed to the variance in water years and the timing at which aerial photos were used for habitat typing. The continued annual monitoring is required to detect any significant trend in habitat area per stream length on the South Fork Eel River.

2.3.2.1.3 ***Van Duzen River***

The Van Duzen River portion of the action area reflects a long legacy of upstream and upslope impacts coupled with the effects of continued instream disturbances. The effects of past floods, coupled with intensive land management coalesce in the low-gradient, unconfined reaches of the lower river. In this setting, the reach is inherently unstable – experiencing wide swings in low-flow channel location from year to year. Stream habitat in this reach is transient and reflects the interaction of streamside vegetation, valley walls, higher alluvial bars and LWD. Each of these habitat influencing elements is in limited supply and salmonids are confined to a limited number of suitable spawning and rearing sites. Rearing habitat is severely limited in the reach due to high water temperatures and poor habitat quality. The Van Duzen has been listed in California's 303(d) list for sediment beginning in 1992 (EPA 1999a).

The reach also functions as a migration corridor for both juvenile and adults of all three salmonid species. Past stranding of migrating adults near the mouth due to insufficient water depth highlights the overall degraded habitat conditions. NMFS considers the large width evident along much of the reach to be the key factor limiting habitat formation and, hence, salmonid production in the lower Van Duzen River. This condition is reflected in the lateral instability of the channel. Although channel migration is to be expected in this reach of the river, the lack of habitat forming elements provides little opportunity for the formation of higher quality stream habitat as the stream migrates.

The extraction reach of the Van Duzen River may also provide an important spawning reach for Chinook salmon during moderate- to low-water periods when upstream access is limiting, or fish have been holding in the lower Eel River for a sufficient duration that upstream migration is curtailed in favor of spawning.

Data from habitat surveys is presented in the following tables (Figure 2-6, Table 2-5, and Table 2-6), although no data was collected in the Van Duzen for 2008. Because surveyed reaches were often different lengths and included different bars, the data is not comparable and no trends can be seen. The same situation occurred with temperature data, making it difficult to compare. In some years side channel habitat was included and in others it's unclear if it was included in the survey of the main channel or left out. In 1998 embeddedness for the Van Duzen was recorded as 45 percent to 80 percent.

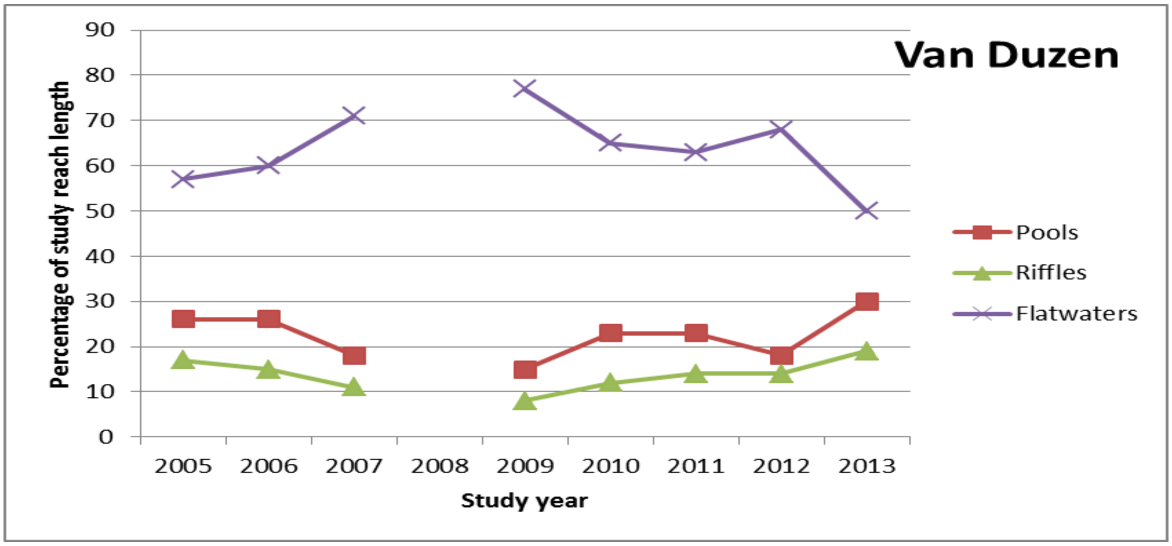

Figure 2-7. Habitat Types by Percent in the Van Duzen 2005 through 2013 (Stillwater Sciences 2014).

Table 2-5. Recorded temperature data during summer low flows

Van Duzen Maximum Sustained Temperatures		
Year	Site	Temperature ºC
1996	Leland Rock	21.9-23.9
1997	Lower Van Duzen	21.9-25
1998	Lower Van Duzen	20-23.9
1999	Lower Van Duzen	18.9-23.9

The 2007 adult-holding, spawning, Age 2+ steelhead, and alcove habitat areas within the extraction reaches covered 33,505 ft², 1,817 ft², 11,540 ft², and 5,134 ft², respectively (Table 15). Between 2006 and 2007, there were significant decreases in adult-holding, Age 2+ steelhead, and alcove habitats. The reduction in the quantity of adult-holding areas appeared to be due to sediment deposition into pools, which resulted in shallowing and shortening of these habitat types (Table 18). In addition, because no monitoring was conducted at the Noble site, significant amounts of adult-holding habitat data were not collected. Similarly, the perceived loss of Age 2+ steelhead habitat most likely was due to a lack of Noble monitoring data since the numbers have remained fairly consistent since the exclusion of Noble monitoring data. The bulk of the alcove loss was caused by the filling in of a single unit on Leland Rock's operation and lack of data collection at the Noble site.

Table 2-6. Lower Van Duzen River mapped habitat unit areas for 2006–2013 (Stillwater Sciences 2014).

Operator/Bar	2006	2007	2008	2009	2010	2011	2012	2013
Adult Holding (ft²)								
Tom Bess	35,062	24,454	ns	26,306	36,971	38,768	38,075	76,179
Noble	103,228	ns	ns	27,008	ns	ns	ns	ns
Leland Rock	34,507	9,051	ns	12,467	16,475	18,441	15,665	13,743
Total	**172,797**	**33,505**	**ns**	**65,780**	**53,446**	**57,209**	**53,740**	**89,922**
Spawning (ft²)								
Tom Bess	0	1,817	ns	7,095	2,948	2,671	3,307	35,131
Noble	0	ns	ns	15,800	ns	ns	ns	ns
Leland Rock	0	0	ns	6,976	12,989	1,311	0	15,659
Total	**0**	**1,817**	**ns**	**29,870**	**15,937**	**3,981**	**3,307**	**50,790**
Age 2+ steelhead habitat area (ft²)								
Tom Bess	6,036	5,115	ns	2,986	19,569	36,845	20,725	25,133
Noble	4,961	ns	ns	3,348	ns	ns	ns	ns
Leland Rock	5,691	6,425	ns	1,296	36,762	79,952	26,514	14,596
Total	**16,688**	**11,540**	**ns**	**7,630**	**56,331**	**116,798**	**47,238**	**39,729**
Coho habitat area (ft²)								
Tom Bess	0	0	ns	0	2,712	4,058	4,031	3,763
Noble	0	ns	ns	0	ns	ns	ns	ns
Leland Rock	0	0	ns	0	2,626	0	0	3,165
Total	**0**	**0**	**ns**	**0**	**5,328**	**4,058**	**4,013**	**6,928**
Alcove (ft²)								
Tom Bess	10,749	5,134	ns	3,852	0	0	0	7,931
Noble	27,562	ns	ns	0	ns	ns	ns	ns
Leland Rock	46,305	0	ns	2,649	9,406	37,838	12,739	18,892
Total	**84,616**	**5,134**	**ns**	**6,501**	**9,406**	**37,838**	**12,739**	**26,823**

There may be errors associated with the habitat mapping effort caused by the different discharges between the dates when aerial photographs were flown and when the mapping was conducted. For example, the 2006 and 2007 aerial photographs were taken when the river discharges at Bridgeville were 570 and 218 cfs, respectively. Discharges for the 2006 and 2007 mapping efforts were 8 cfs, and 7 cfs, respectively. This resulted in estimating edges of habitat polygons in relation to morphological features that were submerged on the aerial photographs.

2.3.2.2 Eel River Baseline Summary

2.3.2.2.1 ***Lower Eel River Reach***

The lower Eel River is defined here as the gravel extraction reach between the mouth of the Van Duzen River to just below Fernbridge (Figure 2-8). Historic land and water management practices, as described generally for Humboldt County, contributed to loss of habitat diversity within the lower mainstem Eel River. Habitat in this area has been characterized as being more homogeneous and simplified in comparison to other Humboldt County extraction reaches

(Halligan 1996). Cooling trends in downstream water temperatures continue to provide habitat for listed salmonids in the lower Eel River. Cool water seeps, thermal stratification, and habitat complexity all play important roles in sustaining micro-habitat for juvenile and adult salmonids. Fishery data indicate depressed or declining abundance trends, yet observational data indicate natural populations persist in the Eel River, albeit at low levels. The degraded condition of the estuary, coupled with the marginal habitat conditions in the rest of the Eel River because of elevated temperatures, high sediment loads, paucity of woody debris, and presence of Sacramento pikeminnow highlight the importance of the lower Eel River to salmonids, especially Chinook salmon and steelhead.

The lower Eel River portion of the action area serves as an important holding area and migration corridor for salmonids. Therefore, conditions encountered along this reach, particularly during low-water periods, influence salmonid populations in the entire Eel River basin. We expect that adult CC Chinook salmon are most sensitive to conditions in this reach because they are known to enter the lower river in late summer and early fall when high water temperatures and low stream flows create stressful conditions for adults prior to upstream migration. Since the Eel River is one of the largest river systems in the ESUs of the salmonids considered in this Opinion, conditions that influence basin-wide populations will have a measurable effect at the ESU level as well.

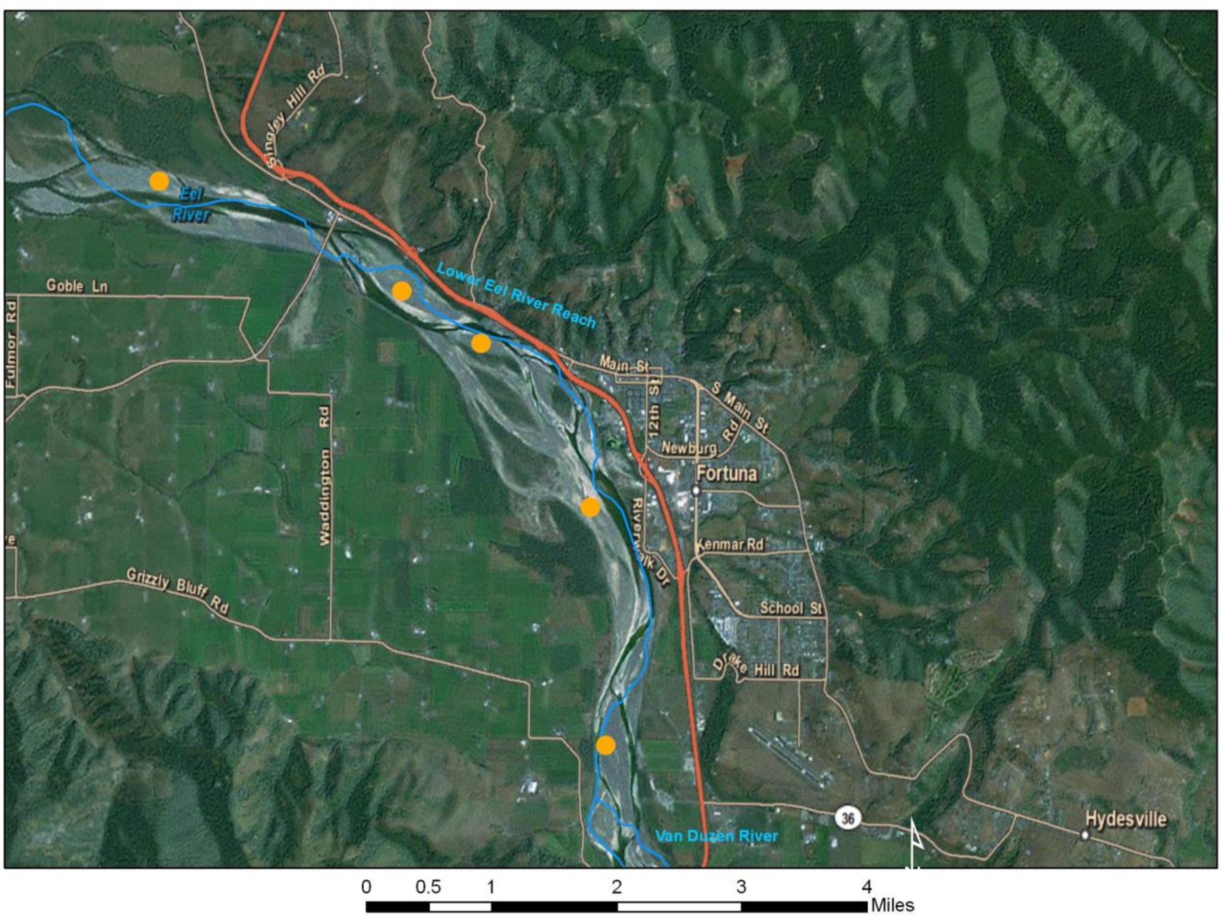

Figure 2-8. Gravel Mining Sites on the Lower Eel River as proposed in LOP 2015-1.

2.3.2.2.2 *Middle Eel River Reach*

Historic land and water management practices have contributed to loss of habitat diversity within the middle Eel River above the Van Duzen River. Existing conditions indicate that the middle Eel River has limited rearing habitat due to elevated water temperatures, high sediment loads, paucity of woody debris, and competition/interaction with Sacramento pikeminnow. Cool water seeps, thermal stratification, and habitat complexity all play critical roles in sustaining micro-habitat for juvenile and adult salmonids. Spawning habitat is present, and the reach is likely important during low water years when fish are confined to the lower river reaches. Fishery data indicate that individual natural populations of anadromous salmonids persist at low levels in the Middle Eel River. Persistence of salmonids in the reach is influenced by upstream flow releases, predation from Sacramento pikeminnow, and activities which occur upslope in the watershed. Upstream activities and past floods have contributed to generally degraded habitat conditions along the middle Eel River. Analysis of aerial photos presented by PALCO (2003) suggests that the river has been in a similar configuration since the 1940s. However, we caution that this inference is based on a limited set of historic photos and does not permit evaluation of more specific habitat indicators such as pool depths, substrate size and overall habitat complexity.

The Middle Eel River portion of the action area serves as a migration corridor and provides limited juvenile rearing area for salmonids. In low-water years, the reach provides important Chinook salmon spawning habitat. For these reasons, conditions encountered along this reach, particularly during low-water periods, influence salmonid populations in the entire Eel River basin upstream of the Van Duzen River. We expect that adult CC Chinook salmon are most sensitive to conditions in this reach because they are known to enter the lower river in late summer and early fall, when high water temperatures and low stream flows create stressful conditions for adults prior to upstream migration. Because the Eel River is one of the largest river systems in the ESUs of the salmonids considered in this Opinion, conditions that influence basin-wide populations will have a measurable effect at the ESU level as well.

The Middle Eel River portion of the action area extends from near the town of Scotia to approximately three miles upstream of the South Fork Eel River confluence. Gravel extraction volumes are greatest near the town of Scotia. Gravel extraction addressed in this Opinion will occur at up to twelve sites on the middle Eel River.

2.3.2.2.3 *South Fork Eel River Reach*

Gravel extraction has occurred at up to twelve sites located at three general locations on the South Fork Eel River (Figure 2-9). Historic land and water management practices have contributed to loss of habitat diversity within the South Fork Eel River. The South Fork Eel River reach provides habitat for all life stages of the three salmonid species considered in this Opinion. Existing conditions indicate that the South Fork Eel River has limited rearing habitat due to elevated water temperatures. Cool water seeps, thermal stratification, and habitat complexity all play critical roles in sustaining micro-habitat for juvenile and adult salmonids. Spawning habitat is present and actively used, as indicated by observations of redds at the Cook's Valley site. Fishery data indicate that individual natural populations of anadromous salmonids persist at low levels in the South Fork Eel River.

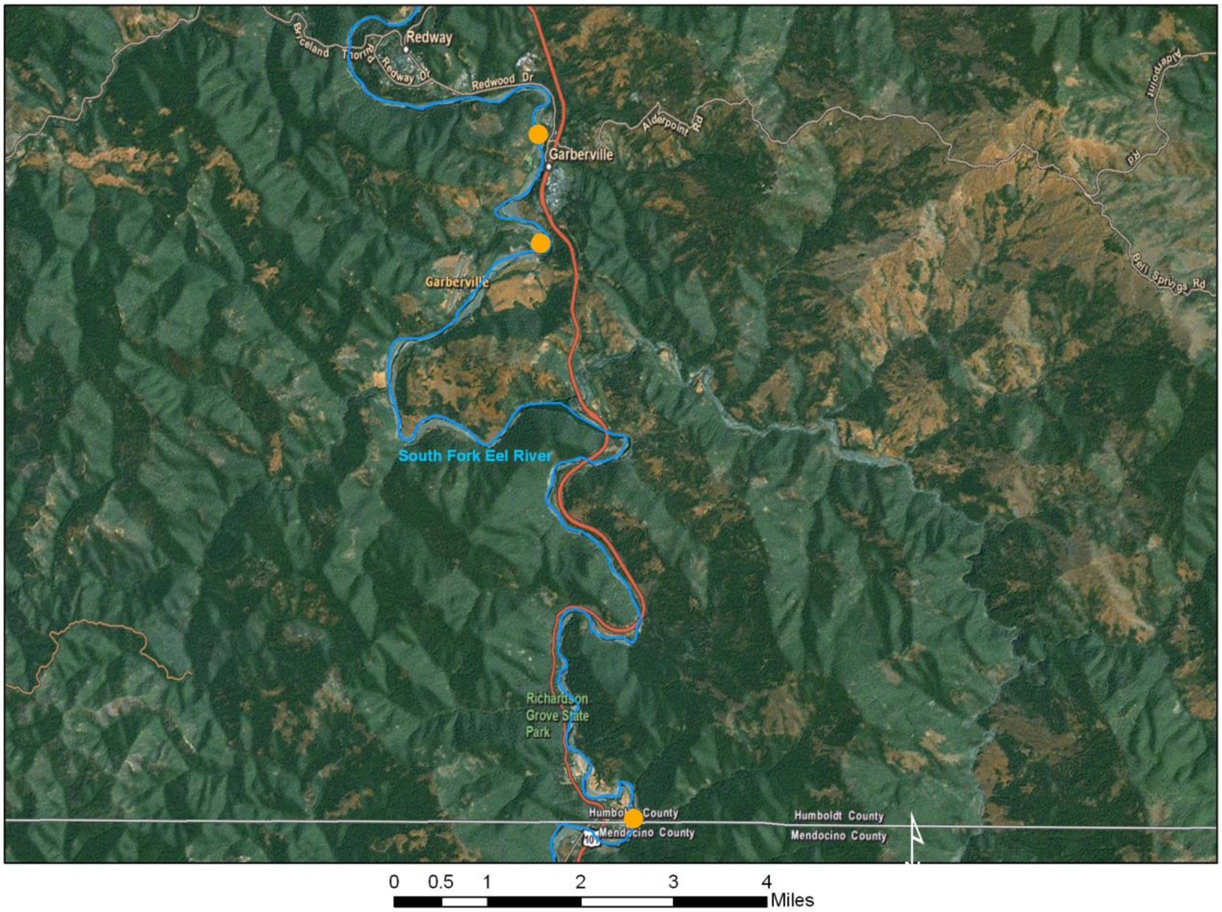

Figure 2-9. Gravel mining sites on South Fork Eel River proposed in LOP 2015-1.

2.3.2.2.4 ***Van Duzen River Reach***

The Van Duzen River portion of the action area reflects a long legacy of upstream and upslope impacts, coupled with the effects of continued instream disturbances. The effects of past floods, coupled with intensive land management, coalesce in the low-gradient, unconfined reaches of the lower river. In this setting, the reach is inherently unstable, experiencing wide swings in low-flow channel location from year to year. Stream habitat in this reach is transient and reflects the interaction of streamside vegetation, valley walls, higher alluvial bars, and LWD. Each of these habitat-influencing elements is in limited supply and salmonids are confined to a limited number of suitable spawning and rearing sites. Rearing habitat is severely limited in the reach due to high water temperatures and poor habitat quality.

The reach also functions as a migration corridor for both juvenile and adults of all three salmonid species. Past stranding of migrating adults near the mouth due to insufficient water depth highlights the overall poor habitat conditions present. NMFS considers the large width evident along much of the reach to be the key factor limiting habitat formation and, hence, salmonid production in the lower Van Duzen River. This condition is reflected in the lateral instability of the channel. Although channel migration is to be expected in this reach of the river, the lack of habitat forming elements provides little opportunity for the formation of higher quality stream habitat as the stream migrates.

The extraction reach of the Van Duzen River may also provide an important spawning reach for Chinook salmon during moderate- to low-water periods when upstream access is limiting, or fish have been holding in the lower Eel River for a sufficient duration that upstream migration is curtailed in favor of spawning. As such, the extraction reach of the Van Duzen River represents a critical low-water year Chinook salmon spawning stretch for the entire Eel River system. Since the Eel River is one of the larger river systems in the three listed salmonid ESUs, activities that adversely affect the lower Van Duzen River may have a demonstrable effect on the CC Chinook salmon, SONCC coho salmon and NC steelhead ESUs if those effects are sustained and dramatically alter the habitat conditions throughout the reach.

In considering the effects of gravel extraction along the Van Duzen River in this Opinion, we reviewed historic aerial photos of the reach to qualitatively determine reach-scale habitat conditions. Our review shows that the Van Duzen River is extremely dynamic - experiencing wide shifts in low flow channel location from year to year. Pool habitat at low flows, if any flow is present, is shallow (Halligan 2003) and lacks complexity from channel roughness elements such as woody debris and streamside vegetation. Most high quality pools that provide depth, cover and velocity refuge appear to occur when the low flow channel abuts bedrock outcrops along the southern valley wall (left bank). Locations of these pools are not fixed as the channel migrates across the floodplain. However, they appear to represent the highest quality pool habitat along the lower Van Duzen River. In other locations, higher quality pools are also associated with streamside vegetation (primarily willow patches) and, to a lesser degree, accumulations of woody debris. Pools also occur where the low flow channel abuts higher elevation bars. Further examination of the aerial photos and site visits suggest that bars approaching bankfull height are capable of providing somewhat higher quality habitat features, including alcove habitats, at moderately high flows, than locations where the low flow channel is unconstrained by these highest bars. These latter habitat-influencing elements (vegetation, woody debris and high bars) are transient features, given the frequent shifts in channel location through time, and we would emphasize that only moderate-quality habitats, at best, occur at these sites. However, given the overall poor habitat condition of the reach, with extensive stretches of uniform, flatwater habitat, these moderate quality habitats represent valuable sites for various life history stages of salmonids. The persistence of salmonids in the reach is influenced by these habitat conditions in addition to the larger scale factors discussed in the *Environmental Baseline* section of this Opinion. Extraction in the reach occurs at the upstream end of the reach, near the confluence with Yager Creek, and the lower end at and near the mouth (Figure 2-10). The middle portion of the reach is unmined.

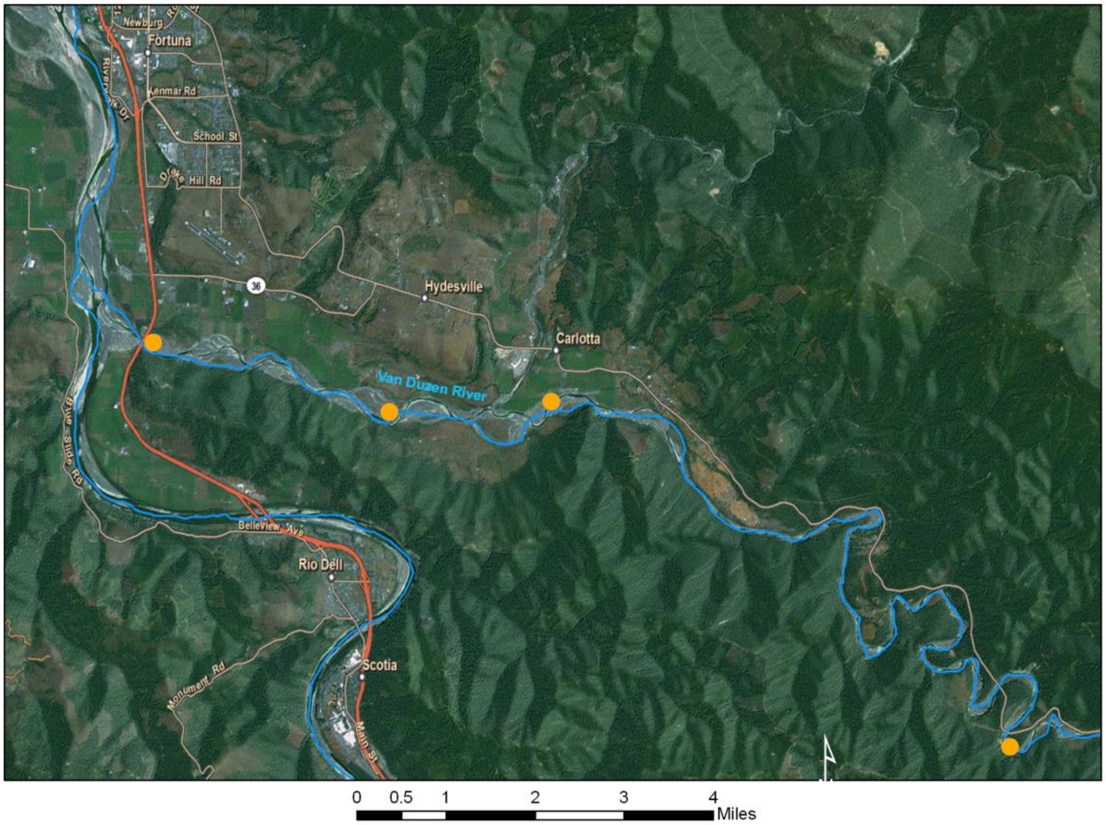

Figure 2-10. Gravel mining sites on the Lower Eel River and the Van Duzen River proposed in LOP 2015-1.

2.3.3 Trinity River Baseline

2.3.3.1 General Setting and Location

The Trinity River is the largest tributary to the Klamath River, entering at Weitchpec at RM 43. The basin drains an area of 3,000 mi² in Northern California, of which about one-fourth is above Lewiston Dam at RM 112. Approximately 70 percent of the basin is under public ownership, including the USDA Forest Service (USFS), BLM, Bureau of Reclamation, and various state and county entities (EPA 2001). The Hoopa Valley Reservation is located north of Willow Creek along the river. Terrain in the basin is predominantly mountainous and forested. Elevations in the basin range from 300 ft at the confluence with the Klamath River to 8,888 ft in the headwaters (EPA 2001). Vegetation along the river typically consists of willows and alders, and the upland forest is generally composed of mixed conifers and hardwoods.

Mean annual precipitation in the basin is approximately 56 in, most of which occurs between October and April (http://streamstats.usgs.gov/gagepages/HTML/11530000.htm). From 1964 to 2008, annual mean flow at the Hoopa gage (USGS #11530000) averaged 4,905 cfs, was highest in 1983 (11,350 cfs), and was lowest in 1977 (786 cfs). For the same period, monthly mean flow was highest in January (averaging 10,826 cfs), and lowest in September (averaging 691 cfs).

The geology of the Trinity River watershed includes pre-Cenozoic metamorphic rocks, Paleozoic and Mesozoic sedimentary and volcanic rocks that are strongly metamorphosed in places, intrusive ultramafic and granitic rocks, and unconsolidated deposits of Cenozoic age. Because of the steep terrain, locally weak earth materials, frequent seismic activity, and high levels of precipitation, many hillslopes in the Trinity basin are susceptible to mass wasting and surface erosion (USFS 2003). For this reason, the Trinity River and its tributaries are subject to high sediment loads. The presence of long-term high sediment loading within the Trinity River system is demonstrated by the presence of extensive alluvial deposits throughout the area. In many cases, human activities in the watershed have resulted in significant increases in erosion and subsequent sedimentation (EPA 2001, USFS 2003). The mainstem Trinity River watershed was listed by the State of California as water quality impaired due to sediment, and a TMDL analysis was completed under Section 303(d) of the Federal Clean Water Act (EPA 2001).

The Trinity River Diversion (TRD), comprised of Trinity and Lewiston dams and Clear Creek Tunnel, was constructed in the early 1960s and has had a major impact on the flow, function, and salmonid habitat in the Trinity River. In addition to blocking migration to historical spawning areas, elimination of the upstream, hydrologically different, snowmelt-dominated reaches, has greatly reduced diversity of the entire river system, thus reducing habitat complexity for salmonids (USFS 2003). In addition, the Bureau of Reclamation exports Trinity River water to the Sacramento basin, and until 1992, up to 90 percent of the annual flow into Trinity Reservoir has been diverted. (North Coast Water Quality Control Board 1989). A 1992 Department of the Interior Secretarial Order required a minimum of 340,000 acre ft annually to remain in the Trinity River (USFWS 1999).

Upstream impoundment has altered the timing and duration of flows in the mainstem Trinity River, resulting in changes in seasonal water temperature regimes (Zedonis 2003). The storage of snowmelt runoff above the dams has resulted in warmer springtime temperatures in the mainstem compared to pre-dam conditions. Water temperatures that exceed levels tolerable for coho salmon and other cold-water species commonly occur in the summer and have been recorded near extraction reaches. For example, the USFWS documented average daily water temperatures above 72°F (22°C) at Weitchpec (RM 0.1) from approximately mid-July to early-August 2002, with some days averaging >75°F (24°C; Zedonis 2003). Halligan (1997a, 1998) and Jensen (2000) recorded summer water temperatures in the Willow Creek project area, and found that daily water temperatures from mid-July through August 1996 generally ranged from 64 to 77°F (18 to 25°C), with a maximum of 80°F (27°C). Daily water temperatures from mid-July through August 1997 ranged from 68 to 77°F (20 to 25°C), with a maximum of 78°F (26°C). Daily water temperatures from mid-July through August 1999 ranged from 64 to 73°F (18 to 23°C), with a maximum of 74°F (23°C). Deep stratified pools or colder tributaries may offer a refuge for coho salmon and other juvenile salmonids during these warm periods (Nielsen *et al.* 1994).

The Trinity River portion of the action area extends from Hoopa Valley upstream for approximately 25 miles to Salyer. The channel is moderately confined in the reach with large-scale roughness features such as bedrock bluffs and large alluvial valley floors providing a degree of stability with respect to individual habitat units. Mining sites are dispersed through the reach, with extraction sites in Hoopa Valley, Willow Creek (approximately 12 miles upstream of

Hoopa), and Salyer. The wetted channel width at high flow varies from 250 ft in the more confined reaches to over 500 ft at the primary extraction areas. Because the Trinity River extraction areas are bed rock controlled and higher gradient, the channel tends to be much more stable than lower gradient alluvial rivers.

SONCC coho salmon is the only ESA-listed salmonid species in the Trinity River. Coho salmon utilize the project reaches primarily for adult and juvenile passage and possibly rearing during outmigration in cold water refugia at the motuhs of tributaries in the summer, but primarily during fall, winter, and spring when stream temperatures are more suitable. Coho salmon are generally thought to spawn in the tributaries, or in the mainstem above the action area (USFS 2003). Klamath Mountain Province steelhead and Upper Klamath-Trinity Chinook salmon are also found in the Trinity River, but NMFS determined that these species did not warrant listing under the ESA.

Information on coho salmon population trends in the Trinity River basin is incomplete, but available information indicates that populations are small to nonexistent in some years. Existing information indicates that coho salmon adults are present in the Trinity River in early September and juvenile coho salmon are present in the mainstem Trinity River throughout the year, including summer months, and also inhabit a number of tributaries (NMFS 1999). Returns to Trinity River Hatchery for the period 1973 to1980 averaged 3,277 adults (Leidy and Leidy 1984). An average of 2,700 SONCC coho salmon returned to Trinity River Hatchery from 1991 to 1995 (CDFG 1992a, 1993, 1994, 1995). During this period an average of 5,600 coho salmon spawned in river, of which approximately 98 percent (5,500) were hatchery returns spawning in river (USFWS 1999). From 1991 through 1995, naturally produced SONCC coho salmon spawning in the Trinity River upstream of the Willow Creek weir averaged 200 fish, ranged from 0 to 14 percent of the total annual escapement (an annual average of 3 percent) (Table 2-18, USFWS 1999).

Table 2-7. Naturally produced adult spawner escapement estimates from Hoopa Tribal Fisheries

	Naturally Produced Adult Spawner Escapement								Trinity River Hatchery – Adult Spawner Escapement							
	Fall Chinook [e]		[e]		Steelhead[e]		Coho		Fall Chinook		Spring Chinook		Steelhead		Coho	
Year	Actual	% of Target Goal	Actual	% of Target Goal	Actual	% of Target Goal	Actual	% of Target Goal	Actual	% of Target Goal	Actual	% of Target Goal	Actual	% of Target Goal	Actual	% of Target Goal
1992	9,513	15%	2,236	37%	1,540	4%	ND	ND	4,651	52%	1,794	60%	455	5%	ND	ND
1993	8,986	14%	2,026	34%	1,176	3%	ND	ND	1,499	17%	3,206	107%	885	9%	ND	ND
1994	10,044	16%	4,129	69%	2,410	6%	ND	ND	11,880	132%	2,659	89%	411	4%	ND	ND
1995	52,462	85%	ND	ND	1,867	5%	ND	ND	53,263	592%	ND	ND	705	7%	ND	ND
1996	34,822	56%	10,892	182%	1,703	4%	ND	ND	20,824	231%	12,524	417%	4,012	40%	ND	ND
1997	11,370	18%	11,736	196%	ND	ND	232	17%	9,977	111%	8,303	277%	429	4%	1732	82%
1998	19,653	32%	7,393	123%	ND	ND	886	63%	23,536	262%	8,774	292%	441	4%	9008	429%
1999	5,435	9%	3,677	61%	ND	ND	440	31%	13,081	145%	7,616	254%	1,571	16%	4281	204%
2000	16,592	27%	6,353	106%	ND	ND	288	21%	38,881	432%	19,730	658%	768	8%	9704	462%
2001	23,125	37%	7,571	126%	ND	ND	2945	210%	33,984	378%	12,051	402%	2,333	23%	25395	1209%
2002	11,272	18%	13,886	231%	4,551	11%	372	27%	6,884	76%	24,599	820%	6,038	60%	13849	659%
2003	11,418	18%	14,249	237%	3,837	10%	3264	233%	52,944	588%	33,546	1118%	10,224	102%	20721	987%
2004	3,578	6%	4,823	80%	4,732	12%	7830	559%	25,956	288%	11,324	377%	5,725	57%	24122	1149%
2005	8,559	14%	3,022	50%	5363		2660		19,670	219%	1,794	365%	14049		28690	
2006	13,202		3,834		8,681		1426									

2.3.3.2 Habitat Condition

The Trinity River portion of the action area extends from Hoopa Valley upstream for approximately 25 miles to Salyer. The channel is moderately confined in the reach with large-scale roughness features such as bedrock bluffs and large, coarsely-armored alluvial terraces, providing a degree of stability to the location of individual habitat units. Mining sites are dispersed, with extraction sites in Hoopa Valley, Willow Creek (12 miles upstream of Hoopa) and Salyer (Figure 2-11).

Salmonids in the Trinity River are largely influenced by regulated flows from Lewiston Dam, Trinity River Hatchery, and cumulative effects from upstream watershed areas. Habitat conditions in the Trinity River portion of the action area appear to be dictated by the confined, bedrock-controlled configuration of the reach. Habitat restoration is occurring, but increased river flows are the keystone of the restoration approach. Frequent deep pools, coarse substrate and a relatively confined low flow channel provide relatively suitable habitat conditions in the excavated areas. SONCC coho salmon, the only ESA-listed species in the Trinity River, utilize the extraction reach primarily for migration and rearing, although some spawning may occur, particularly in low-water years.

Habitat within the action area is used by coho salmon primarily as a migration corridor for adults moving upstream to spawn in tributary streams. Data on the occurrence of mainstem spawning are limited due to poor water visibility during the spawning period. Juvenile coho salmon use the project area primarily for outmigration to the ocean in the spring and early summer. It is unlikely that coho salmon regularly rear in project reaches during the extraction period due to lack of preferred habitat and warm summer water temperatures (Zedonis 2003); although some juvenile coho summer rearing cannot be ruled out (D. Halligan, Stillwater Sciences, personal obervation). Juevnile coho salmon may rear for short periods near the extraction sites during periods when water temperatures are more favorable *i.e*., fall, winter, and spring.

Coho salmon have been documented spawning and outmigrating in Willow Creek (USFS 2003). In addition, they have been documented in Horse Linto Creek (approximately 5 miles downstream of the extraction area) and Sharber Creek (several miles upstream of the McKnight site). On the HVIR, coho salmon have been observed in Campbell Creek, Mill Creek, Soctish Creek, and Supply Creek. However, it is unknown if recent juvenile sightings are a result of adult spawning in those watersheds or non-natal rearing of juveniles from elsewhere in the Trinity River. Since known spawning tributaries are near the extraction sites, some juvenile coho salmon likely use the mainstem for rearing during cooler periods. Coho juveniles likely utilize low-velocity areas within extraction reaches as refuge during high winter flows, and for rearing leading up to outmigration. Mainstem juvenile rearing in the Trinity River is thought to occur primarily in the upper mainstem upstream of the North Fork (USFWS 1999), however, juveniles undoubtedly feed while migrating through the action area and may rear for small periods of time if access to suitable habitat is available.

2.3.3.3 Trinity River Baseline Summary

The Trinity River portion of the action area extends from Hoopa Valley upstream for approximately 25 miles to Salyer. The channel is moderately confined in the reach with large-scale roughness features such as bedrock bluffs and large, coarsely-armored alluvial terraces, providing a degree of stability to the location of individual habitat units. Mining sites are dispersed, with extraction sites in Hoopa Valley, Willow Creek (12 miles upstream of Hoopa) and Salyer (Figure 2-11).

Salmonids in the Trinity River are largely influenced by regulated flows from Lewiston Dam, Trinity River Hatchery, and cumulative effects from upstream watershed areas. Habitat conditions in the Trinity River portion of the action area appear to be dictated by the confined, bedrock-controlled configuration of the reach. Habitat restoration is occurring, but increased river flows are the keystone of the restoration approach. Frequent deep pools, coarse substrate and a relatively confined low flow channel provide relatively suitable habitat conditions in the excavated areas when water temperatures are suitable. SONCC coho salmon, the only ESA-listed species in the Trinity River, utilize the extraction reach primarily for migration and rearing during periods when stream temperatures are suitable (fall, winter, spring).

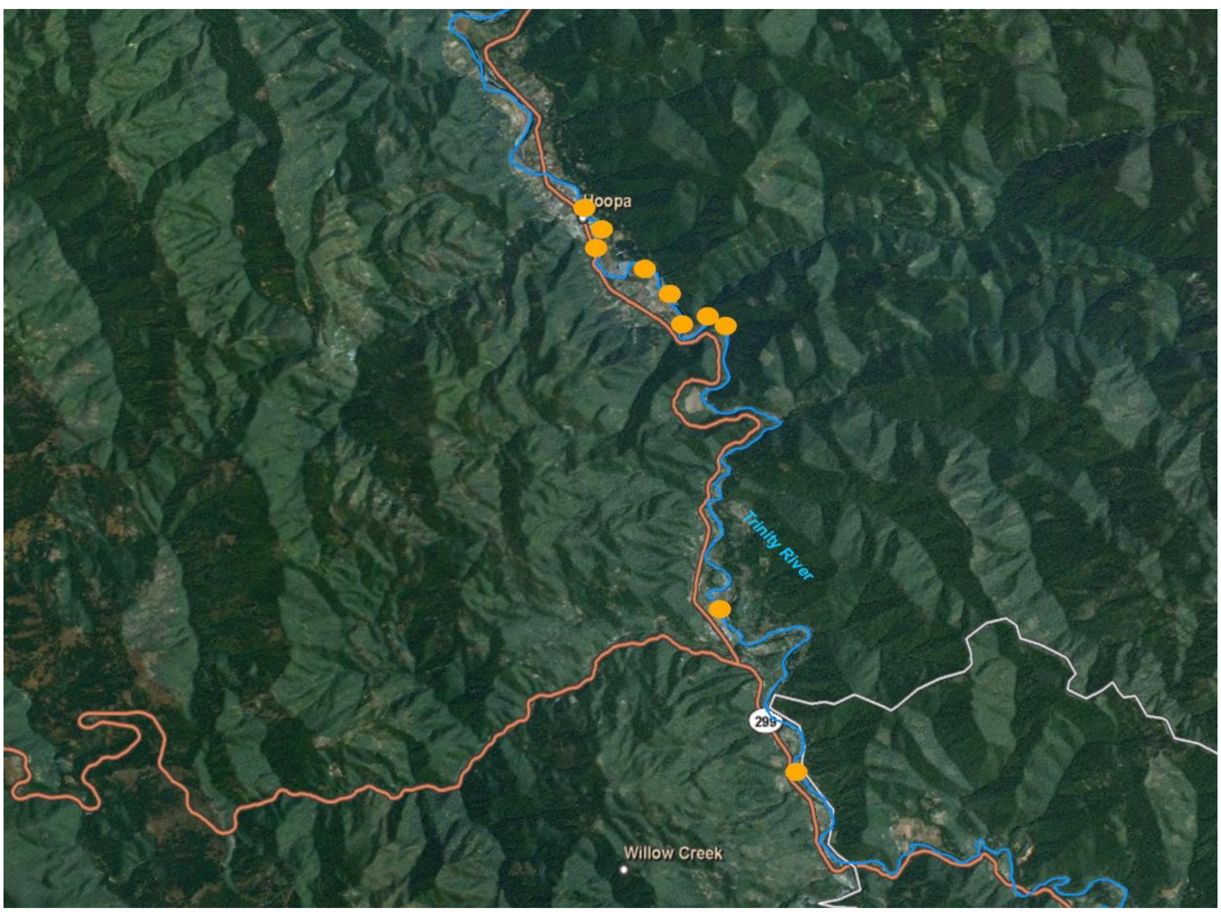

Figure 2-11. Trinity River gravel mining sites.

2.3.4 <u>Description of Isolated Extraction Sites in the Action Area</u>

2.3.4.1 Mattole River

2.3.4.1.1 ***General Setting and Location***

The Mattole River basin encompasses approximately 296 mi^2 (767 km^2), beginning in the Coast Range Mountains of northern California and draining into the Pacific Ocean near Petrolia. Rainfall in the basin averages 81 in per year, and hydrology in the basin is considered flashy due to high seasonal rainfall on geologic units with relatively low permeability and steep slopes (NCWAP 2003). The Mattole River basin has a history of extensive logging and associated road building, which has impacted nearly the entire basin and contributed to widespread landsliding and channel aggradation following the 1964 flood.

Major tributaries to the Mattole River, from downstream to upstream, include the Lower North Fork Mattole, Squaw Creek, Upper North Fork Mattole, Honeydew Creek, Mattole Canyon Creek, and Bear Creek. The focus of this environmental baseline is on the Lower North Fork Mattole River.

The North Fork Mattole River enters the mainstem at around RM 5.5. The North Fork Mattole River watershed encompasses approximately 39 mi^2 (101 km^2). Over 99 percent of the "Northern Subbasin", which includes the North Fork Mattole River, is privately owned and managed primarily for timber production and grazing (NCWAP 2003).

2.3.4.1.2 ***Population Viability***

The Mattole River qualifies as one of the 15 independent populations of CC Chinook Salmon. Ancillary data indicated that fall-run Chinook salmon persist in watersheds of the northern part of the ESU, including the Mattole River. It has been concluded that the Mattole River population was at least at moderate risk of extinction based on low adult abundances and apparent population declines in recent years (Spence *et al*. 2008).

Abundance data for winter run NC steelhead in the Mattole River is data deficient and no determination was made for their extinction risk. Abundance data for summer-run populations are somewhat more available. Limited data from the Mattole River suggest that the population likely numbers fewer than 30 fish and thus concluded it is at high risk of extinction (Spence *et al.* 2008).

The Mattole River SONCC coho population is at a high risk of extinction and is not viable based on the low abundance. There were an estimated 500 spawners in 1981 to 1982, a peak of greater than 1,000 spawners in 1987 to 1988, and less than 200 spawners in 1994 to 1995. More recent data suggests that the number of spawning adults is less than 20 individuals, leaving this population vulnerable to the effects of depensation. Although there may be higher numbers of spawners occasionally in some years, the overall number of coho salmon in the Mattole River watershed is extremely low compared to historic conditions.

2.3.4.1.3 ***Habitat Conditions***

Channel conditions

The North Coast Watershed Assessment Program (NCWAP 2003) reported that sediment delivery has had an adverse and long-lasting impact to salmonid habitat in the Northern Subbasin. Aerial photograph analysis indicated that the lower reaches of large tributaries to the Mattole River are highly aggraded with fine sediment (NCWAP 2003). Late summer field observations showed that aggradation and channel widening have likely contributed to a loss of surface streamflow (NCWAP 2003). The lower reach of the North Fork Mattole River channel at the Cook Bar project area was observed to be dry during a field review in September 1999 (D. Halligan, Stillwater Sciences, personal observation). Although the North Fork Mattole River channel is usually dry during the late summer and fall, it may reach over 400-ft wide during high flow events. The thalweg at the Cook Bar is relatively unstable due to its location on an alluvial fan at the mouth of the North Fork Mattole River.

Due to the location of the Cook Bar at the confluence of the North Fork and mainstem Mattole River, bedload from both systems contribute to its replenishment. Reported estimates of suspended sediment and bedload for both the North Fork and mainstem Mattole River are summarized below.

In 1967, suspended sediment discharge in the Mattole River was estimated to be 16,370 tons/mi^2/yr (Kennedy and Malcolm 1977 as cited in NCRWQCB 2002). Assuming bedload is 8 to16 percent of suspended load (Collins and Dunne 1990), bedload for 1967 is estimated to have been 1,310 to 2,620 tons/mi^2/yr. Applying a conversion of 1.5 tons per cubic yard, bedload would be approximately 873 to 1,747 yd^3/mi^2/yr. For the approximate 257mi^2 of the Mattole River basin upstream of Petrolia, this equates to an annual bedload of 224,361 to 448,979 yd^3.

The California Department of Water Resources (CDWR 1973) listed average annual sediment yield for the Mattole River at 2.7 acre-ft per square mile, which equates to an average annual sediment yield of 799 acre-ft per year or 1,289,053 yd^3. This, in turn, equates an annual bedload of 103,124–206,248 yd^3 per year. Jones and Stokes (1981) reported that the average annual sediment yield of the Mattole River, as measured at Petrolia, was approximately 1,330 ac-ft. This equates to an annual sediment volume of 2,145,733 yd3, or an annual bedload of 171,658–343,317 yd^3.

More recent sediment measurements for the basin can be found the Mattole River TMDL (NCRWQCB 2002). The TMDL document estimated the basin produced about 8,000 tons/mi^2/yr. This equates to about 5,333 yd^3/mi^2/yr of sediment yield or 1,434,577 yd^3 per year for the 269 mi^2 basin. Assuming bedload is 8 to 16 percent of suspended load (Collins and Dunne 1990), the annual bedload is estimated to be between 114,766 and 229,532 yd^3 per year.

No sediment yield or bedload estimates have been made specifically for the North Fork Mattole River subbasin; however, two estimates based on the Jones and Stokes (1981) and NCRWQCB (2002) values, respectively, are calculated below. These estimates assume that the North Fork Mattole River subbasin has similar geology and sediment transport processes as the entire Mattole basin, and that its bedload is proportional to the larger basin. The North Fork Mattole drainage area represents approximately 15.2 percent of the Mattole River drainage area upstream of Petrolia (used by Jones and Stokes 1981). Therefore, annual bedload based on the Jones and Stokes (1981) values are approximately 15.2 percent of the 171,658–343,317 yd^3 estimated for the drainage area upstream of Petrolia, or 26,092–52,184 yd^3. Using the bedload range derived from the NCRWQCB (2002) estimates, the estimated average annual bedload in the North Fork Mattole River subbasin is between 17,444 and 34,889 yd^3.

No historical cross-section or longitudinal profile data are available to determine streambed or thalweg elevation trends for the Cook Bar. However, it is safe to assume the low level and periodicity of gravel extraction at this site has had minimal effect on streambed elevation due to the high amount of annual bedload movement.

Water temperature

The Mattole River watershed was listed as water quality impaired due to sediment and temperature by the State of California, and a TMDL analysis was completed under section 303(d) of the Federal Clean Water Act (EPA 2003). High seasonal rainfall combined with a rapid runoff rate on unstable soils contributes to the delivery of large amounts of sediments to the river, and as a result, sediment transport rates in the Mattole River are very high. Much of this sediment is deposited throughout the lower gradient reaches as it is transported downstream through the system.

High summer and fall water temperatures limiting salmonid juvenile rearing success occur throughout the mainstem Mattole River and its tributaries (Welsh *et al*. 2001, Watershed Sciences 2002, NCRWQCB 2002, EPA 2003). Temperature monitoring data collected by the Mattole Salmon Group in summer 2006 indicated weekly maximum water temperature near the confluence with the North Fork peaked at over 81°F (27°C) in late July 2006 (MSG 2007a).

In the North Fork Mattole River, aerial thermal infrared surveys indicated that median surface water temperatures ranged between approximately 73°F (23°C) and 79°F (26°C) in the lower 2 mi. on 20 July 2001 (Watershed Sciences 2002). These surveys indicated water temperatures generally declined in the upstream direction, with measurements as low as 55°F (13°C) at RM 12 (Watershed Sciences 2002). In addition, there was considerable variation in temperature between reaches and indication of sub-surface exchange moderating temperature in the lower reaches.

Despite unfavorable water temperatures throughout the lower Mattole River basin, the existence of thermal refugia, created by tributaries, groundwater seeps, intergravel flow, and deep pools have been documented (NCRWQCB 2002, MSG 2007a). These refugia likely increase survival of salmonids during periods of elevated temperatures (Nielsen *et al*. 1994). Evidence for thermal stratification was seen at RM 2.9 of the North Fork Mattole River, where maximum summer water temperatures of 82°F (28°C) and 75°F (24°C) were recorded on the water surface and at the bottom of a 6 ft-deep pool, respectively (NCRWQCB 2002).

No major dams or power generating facilities are located within the Mattole River basin, however, there are numerous water rights within the Mattole Basin, as well as countless unsanctioned water diversions that likely affect stream flow (NCWAP 2003). ESA-listed salmonids historically (and possibly currently) utilizing the North Fork Mattole River include

SONCC coho salmon, CC fall-run Chinook salmon, and NC winter-run and summer-run steelhead.

2.3.4.1.4 ***Conservation Value of Critical Habitat***

The Mattole River extraction site on Cook Bar (Figure 2-11), is located on both sides of the North Fork Mattole River channel where it flows across the delta at the confluence with the mainstem Mattole River (Klein *et al.* 2000). The only available site-specific data on instream salmonid habitat for the Cook Bar on the North Fork Mattole River were collected in 1999 as part of LOP-96 habitat monitoring requirements. In the summer of 1999, 2,920 ft of the mainstem Mattole River and 211 ft of side channel adjacent to, upstream, and downstream of the Cook Bar extraction area were habitat mapped (Jensen 2000). The North Fork Mattole River within and upstream of the extraction area was dry at the time and was not surveyed. Flatwaters, riffles, and pools in the mainstem comprised 65, 17, and 18 percent of the stream length, respectively. There were 1,900 ft^2 of structural complexity in the flatwaters composed of terrestrial vegetation, LWD, and boulders. There were approximately 550 ft^2 of structural complexity from terrestrial vegetation and boulders associated with the pools. Riffles contained 100 ft^2 of structural complexity. Mean and maximum pool depths averaged 1.3 and 3.6 ft, respectively. Substrate embeddedness ranged from 50 to 75 percent with some spawning habitat present.

The Cook Bar site has not been mined every year. The County of Humboldt uses the bar as a supply site for road repair and maintenance. A maximum extraction quantity of 30,000 cubic yards was permitted for the Cook Bar site in 1999, with 19,028 cubic yards extracted, or 63 percent of the maximum extraction recommended by the CHERT (Klein *et al*. 2000). Although mining has been intermittent at the site, it is likely that there have been limited chronic effects to channel form and function. In combination with other cumulative impacts in the watershed, gravel mining may have caused declines in the quality of salmonid habitat.

Although fish abundance and distribution data are not available for this particular reach of the Mattole River, the presence of CC Chinook salmon, SONCC coho salmon and NC steelhead suggest that all three species may utilize the area for one or more life history stages.

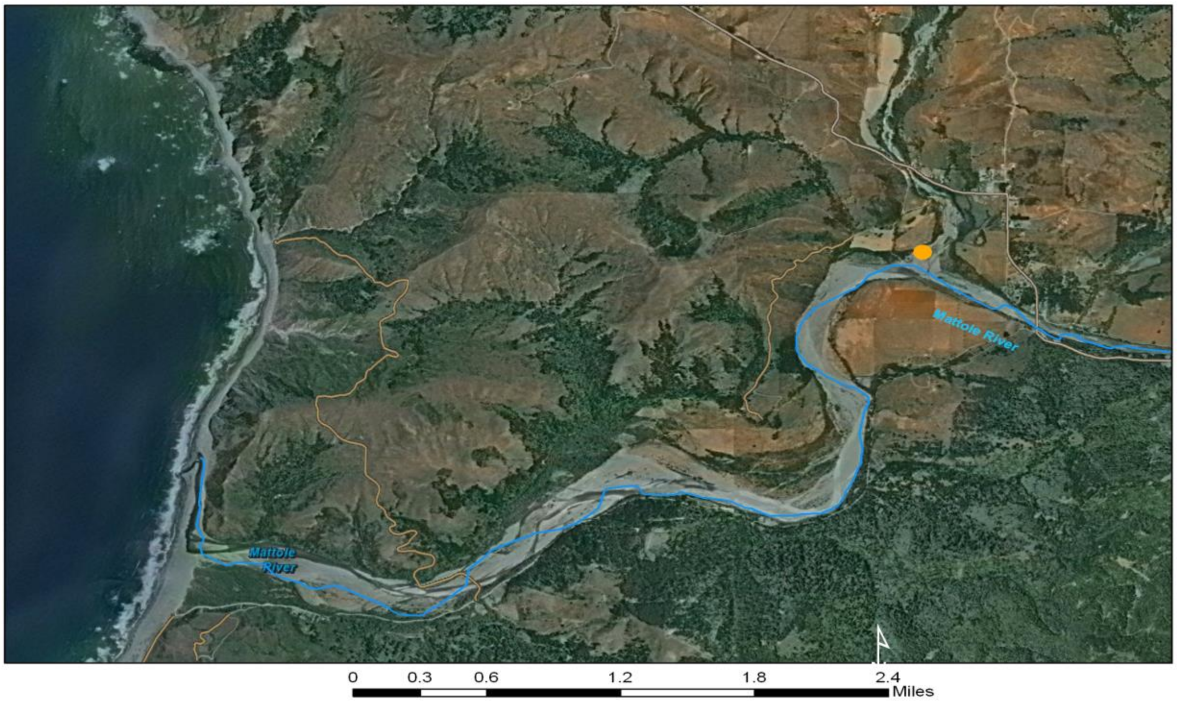

Figure 2-11. Gravel extraction site on the Mattole River as proposed in LOP 2015-1.

2.3.4.2 Fort Seward

2.3.4.2.1 ***General Setting and Location***

The Fort Seward site is located on the mainstem Eel River, at approximately RM 68 (Halligan 1997a). Fort Seward is an isolated site, approximately 24 miles upstream from the other mining sites on the Eel River. Mean annual precipitation at Fort Seward is about 65 in, but may reach 110 in some areas of the basin (ACOE 1999). Most of the precipitation falls between November and April, and many of the smaller tributaries dry up in late summer (EPA 2005). From 1956 to 2008 at the Fort Seward gage (USGS #11475000), the monthly mean flow was highest in January (13,000 cfs) and lowest in September (51 cfs).

Using the Collins and Dunne (1990) range the average annual bedload at Fort Seward for the period between 1966 and 1976 is estimated to be 771,331 to 1,446,244 tons per year or 514,220–964,163 yd^3 per year. A recent sediment source analysis for the Middle-Main Eel River estimated an annual sediment delivery rate of 494 yd^3 per square mile per year for the TMDL analysis area (EPA 2005, Appendix B). Applying this value to the 2,100 mi^2 of basin above Fort Seward results in an estimated 1,037,400 yd^3 of suspended sediment transported per year. Applying the Collins and Dunne (1990) estimate that bedload equals 8 to 16 percent of the suspended load, the annual bedload at Fort Seward is estimated to be 82,992 to 165,984 yd^3 per year.

The Fort Seward site was mined once during LOP 96-1. This section of river is characterized by a bedrock-controlled channel in a more confined river valley than the wider, alluvial valley which characterizes the lower Eel River. Due to the inland location, and the lack of coastal influence, water temperatures consistently remain in the stressful to lethal range for salmonids during the late summer season, when mining operations would commence (Halligan 1998, 1999, Jensen 2000). Specifically, Jensen (2000) found sustained summer high temperatures of 21 to 25°C and a maximum of 27.9°C at Fort Seward. Due to the high water temperatures, salmonids would most likely have migrated to cooler tributaries or downstream locations before late summer. In contrast to the lower Eel River, which contains many active mining sites, Fort Seward is the only mining site located in this section of the Eel River.

The gravel bar at this site is large and unvegetated, has approximately 2.4 m (8 ft) of vertical offset from the low flow river elevation, a cobble layer providing surface armor, and bedrock control on the opposite side of the river. In 2000, a total of 43,200 cubic yards at this site was recommended by CHERT and authorized by the Corps, and 22,908 cubic yards of sediment was actually removed. The stream length adjacent to this bar that may be affected by the proposed action is approximately 610 m (2,000 ft). In the past, NMFS and CHERT have reviewed the site, and have made site specific recommendations to the Corps regarding the location of skimming on the bar, vertical and horizontal offsets, and the appropriate quantity of gravel to be mined. Records indicated that no habitat improvement extraction activities have been conducted at this site due to the infrequent nature of operations, and it is doubtful they will occur in the future unless the site is mined on a more frequent basis.

2.3.4.2.2 ***Population Viability***

The Mainstem Eel River coho salmon population size is unknown, but extremely reduced compared to historic levels. Breeding groups have been lost or severely depressed in some Mainstem Eel River streams. Population growth rate is unknown, but expected to be negative in most years. Therefore, the Mainstem Eel River coho salmon population is at high risk of extinction given the extremely low population size and expected negative population growth rate. The Mainstem Eel River coho salmon population is not viable and at an extremely high risk of extinction. Observations of coho salmon in the Mainstem Eel River are basically nonexistent. NMFS (2014) describes high IP areas as limited in the Mainstem Eel River. The population is likely below the depensation threshold for recovery and at a high risk of extinction (NMFS 2014).

2.3.4.2.3 ***Conservation Value of the Designated Critical Habitat***

In 1993, Parkinson (1994) conducted a habitat survey along 2,600 ft of the mainstem Eel River at Saterlee Bar (Halligan 1998; Table 26). Instream cover elements were composed of large rock substrate, depth in some of the pools, surface agitation in riffles, and some boulder cover in runs and riffles. No significant amounts of LWD or riparian shrub/forest were present adjacent to the channel. Sand and fine gravel filled the interstices in all but the higher velocity areas in runs and riffles.

In 1997, a total of 3,035 ft of the mainstem Eel River adjacent to the Saterlee Bar extraction site was habitat mapped (Halligan 1998; Table 26). The pool shelter rating was low at 20, where CDFG considers a high rating to be 80 to100. Instream shelter was made up of bedrock ledges, boulders, LWD, and bubble curtains. Mean and maximum pool depths averaged 3.3 and 8.2 ft, respectively. Sand made up 40–70 percent of the substrate in pools. Substrate embeddedness ranged from 5 to 50 percent.

In 1999, a total of 3,260 ft of the mainstem Eel River was habitat mapped adjacent to, upstream, and downstream of the primary extraction area at Fort Seward (Jensen 2000; Table 2-18). The low reported value for pool percentage is likely due to the use of different criteria for delineating pools from flatwaters (D. Halligan, Stillwater Sciences, personal observation). Instream cover complexity was made up of bedrock ledges, boulders, and LWD. Mean and maximum pool depths averaged 6.5 and 16 ft, respectively. Substrate embeddedness ranged from 25 to 75 percent, with some spawning habitat present (Stillwater Sciences 2015).

A coarse delineation of habitat units using aerial photographs taken in spring 2008 was conducted by Stillwater Sciences. A comparison of the pool:riffle:flatwater percentages of the four surveys is provided in Table 2-18.

Table 2-18. Comparison of habitat type surveys in the mainstem Eel River adjacent to the Fort Seward extraction site, 1993–2008.

Survey year	Surveyor	Habitat frequency (%)			Total
		Pools	Riffles	Flatwaters	
1993	Parkinson	67	7	23	97[1]
1997	Halligan	48	11	41	100
1999	Jensen	16	30	54	100
2008	Stillwater	58	10	32	100

[1]It is unknown why 1993 habitat percentages do not add up to 100%.

Although fish abundance and distribution data are not available for this particular reach of the Eel River, the presence of CC Chinook salmon, SONCC coho salmon and NC steelhead suggest that all three species may utilize the area for one or more life history stages.

2.3.4.3 Bear River

2.3.4.3.1 ***General Setting and Location***

The Bear River is located near Ferndale and has a drainage area of 81.2 square miles. Mining has occurred infrequently approximately two miles upstream from the Pacific Ocean. Gravel mining in the basin has occurred very infrequently at the Branstetter Bar.

No historical cross-section or longitudinal profile data were available to determine streambed or thalweg elevation trends for the Branstetter Bar, however, it can be assumed that the low level and periodicity of gravel extraction at this site has had minimal effect on streambed elevation due to the high amount of annual bedload. No estimates of annual bedload at the Branstetter Bar have been made.

CC Chinook salmon and NC steelhead are known to occur in the watershed (NMFS 1999), but available data indicate SONCC coho salmon are either extirpated, or in numbers too low for detection (CDFG 2002, NMFS 2014). Little information exists on habitat conditions or salmonid populations in this watershed.

2.3.4.3.2 ***Population Viability***

No known, verifiable historical or current records of coho salmon presence in the Bear River basin are available (Bliesner *et al*. 2006). In 2001, CDFG did not detect coho salmon during systematic presence surveys on four streams in the Bear River basin (CDFG 2002). However, because the Bear River supports populations of Chinook salmon and steelhead and contains reaches with high intrinsic potential for coho salmon (Williams *et al*. 2006), it's likely that coho salmon were present historically.

Wahle and Pearson (1987 as cited in Good *et al*. 2005) estimated a spawning population of 100 Chinook salmon in the Bear River. There are no known older historical or current adult abundance estimates for Chinook salmon in the Bear River basin (Bliesner *et al*. 2006, Spence *et al.* 2008).

In 2001 to 2002, Chinook salmon juvenile outmigrant abundance data was collected by CDFG (Ricker 2002). From April 23 to June 23, 2001, 172 Chinook salmon outmigrants were captured. No population estimates were developed from the 2001 data. From April 9 to June 18, 2002, 1,230 Chinook salmon smolts were captured, which produced an estimate of 3,756 (± 468) age 0+ fish that migrated past the trap site. It should be noted that since trapping was started late in the spring, many of the smolts may have passed the site prior to trap installation and the population estimate may be lower than the actual population size.

Bear River Chinook salmon are fall-run and likely have a life history similar to that observed in the nearby Mattole River. The use of the Bear River extraction reach by Chinook salmon is likely limited to adult and juvenile migration, although some spawning and rearing may occur. The majority of suitable Chinook spawning and rearing habitat is located about 7.5 miles upstream of the mining site (Bliesner *et al.* 2006).

Winter-run steelhead are the most abundant and widely distributed anadromous salmonid species in the Bear River basin (Bliesner *et al.* 2006). Historical accounts indicate that the basin has always been considered an excellent steelhead and resident rainbow trout producer, and according to some accounts and recent juvenile abundance data, the basin still has a healthy population (Bliesner *et al.* 2006). Steelhead have been documented in all major tributaries and several smaller, unnamed tributaries to the Bear River upstream to migration barriers (Bliesner *et al.* 2006).

There are no historical or current abundance estimates for adult steelhead in the Bear River basin (Bliesner *et al*. 2006, Spence *et al*. 2008); however, in 2001 and 2002, CDFG collected outmigrant abundance data as part of their Steelhead Research and Monitoring Program (Ricker 2002). The downstream migrant trap, which was operated from April through early June, captured three age classes of steelhead: young of the year (YOY), age 1+, and age 2+. Population estimates for these age classes were estimated for the basin (Table 2-19).

Table 2-19. Juvenile steelhead population estimates for the Bear River, 2001–2002 (Ricker 2002).

Year	YOY	Age 1+	Age 2+
2001	64,229 (±2,600)	26,793 (±20,647)	21,507 (±6,775)
2002	111,555 (±26,696)	47,524 (±18,806)	7,765 (±6,344)

2.3.5.3.3 Conservation Value of the Designated Critical Habitat

Very little information exists on Bear River instream habitat in or near the gravel extraction reach. Citing CDFG's (2000) habitat surveys, Bliesner *et al*. (2006), reported the percentage of pools, riffles, and flatwater by length for a 7,522 ft reach of the "Lower Bear River" to be 19, 7, and 74 percent, respectively. In the surveyed reach, 95 percent of pools had depths greater than 2 ft. and spawning habitat was ranked as "fair."

In 2005, surveys similar to the 1996 to 2000 CDFG habitat surveys were conducted on HRC property in the mainstem Bear River and several tributaries to allow for comparison of specific habitat metrics (Bliesner *et al*. 2006). In a 7,257 ft reach near RM 20, pools, riffles, flatwater comprised 26, 44, and 30 percent of habitat composition by length, respectively. In the surveyed reach, 79 percent of pools were greater than 3 ft. deep. Refer to Bliesner *et al*. (2006) for a detailed discussion of instream habitat measurements collected in 2005.

No site-specific data on instream salmonid habitat for the Branstetter Bar on the Bear River are available.

2.3.4.4 Pacific Lumber Bar

Pacific Lumber Bar – referred to as PALCO Bar in HCPWs BA - on the Van Duzen River is considered isolated spatially and temporally (Figure 2-10). The location is at RM 16.7, significantly upstream of the other Van Duzen River mined bars. The bar is approximately 18 acres in size and extractions have not exceeded 5 acres. The county has mined this bar infrequently, the most recent extraction occurring in 2013. However, with the demise of the Pacific Lumber Company, who with several SMARA-permitted sites in the Yager Creek drainage (a significant tributary to the Van Duzen River), and who were overly generous in their donation of aggregate to HCPW, those sources are no longer available, exponentially increasing the value of the Palco Bar when considering the maintenance of county roads in this portion of Humboldt County. As such, the Palco Bar site has become of greater importance to HCPW, and will likely be utilized to a greater degree than in years predating the 2013 extraction.

Habitat at the Pacific Lumber Bar was surveyed in October 2003. Residual pool depths ranged from 0.5 to 7.5 feet. Other habitat date regarding the Pacific Lumber Bar was not readily summarized for the BA. Other information on the Van Duzen River watershed baseline has been described previously.

2.3.5 Factors Limiting Survival and Recovery of Salmonids in the Action Area

Based on our review of past and current impacts to salmonids and their habitat, the status and trends of salmonids in the action area and current habitat conditions, agricultural practices, timber harvesting, sport and commercial fishing, reservoirs and regulated flows, and hatcheries continue to limit the survival and recovery of salmonids in the action area. These factors have been described previously.

Little information on historic conditions in the action area exists to assess the resiliency of the reaches to continued impacts. We generally assume that extensive riparian forests and LWD were much more abundant and created complex stream habitats not unlike those described by Abbe and Montgomery (1996) for large, lowland rivers in the Pacific Northwest. For example, in the lower Mad River, Tolhurst (1995) summarized historic descriptions of the river, noting long, deep pools, extensive riparian forests, and cobble substrate. The presence of riparian forests along these reaches likely provided an important stabilizing feature as well as a depositional environment for sediment transported during flood flows.

Watershed disturbances that caused channel responses were likely more stochastic and occurred in a patchwork fashion and channels likely experienced longer periods of quasi-stability in between disturbances (Reeves *et al.* 1995). This is in contrast to current conditions in the action area which reflect watershed-wide disturbances beginning with timber harvest in the late 1800s, followed by extensive road construction, development, and other activities discussed previously in this section. Channels that were once relatively stable over a time frame of years to decades continue to be chronically impacted from upslope and instream activities. Although many of the streams in the action area are widely recognized as having some of the world's highest sediment yields (*e.g.,* Eel River), prior to extensive land altering activities, these high sedimentation rates were likely accompanied by extensive riparian forests and abundant LWD which provided habitat complexity and moderated the impacts of excess sedimentation. Similarly, the resultant channel bedforms were also likely in balance with the high sediment yields such that a quasi-equilibrium was achieved where gravel bars built up in response to the high sediment loads, thereby creating reach-scale roughness elements that promoted the formation of adjacent pool and riffle habitats. A more thorough discussion of the role of bars in habitat formation and maintenance is provided in the *Effects of the Action* section. The result is that across the action area, channels are much more uniformly degraded than in the past, prior to extensive land altering activities, and many of the elements (*e.g.,* woody debris, lowland riparian forests, and in-stream gravel bars) that provide some resiliency to continuing impacts have been and/or continue to be removed from the stream system.

In general, reaches with frequent bedrock exposures along the channel provide a greater degree of resiliency than those reaches in more unconfined valley settings. Bedrock provides a similar role as woody debris and mature gravel bars by forming sites of pool scour and sediment sorting. Reaches where bedrock provides channel roughness include the Trinity, South Fork Eel, and Middle Eel Rivers. In the *Effects of the Action* section, we further discuss the role of bedrock in moderating the effects of the proposed action. This is in contrast to the more unconfined, valley settings of the Van Duzen and the lower Eel Rivers. In these locations, the absence of bedrock controls on stream habitat and sediment routing result in stream reaches that are much more sensitive to disturbance.

The diversity of salmonid populations has likewise declined as the patchwork nature of disturbance that formerly created a mosaic of habitat types and conditions has been replaced with this more pervasive degradation and simplification of habitats (Reeves *et al*. 1997). Resiliency of the current populations is likely much reduced as fewer refuge habitats are available and continued disturbances, both instream and upslope, continue to impact stream habitats and salmonids. Water diversions, as a result of agricultural practices within the ESU interrupt the flow of water, sediment, nutrients, and energy. Many of these diversions occur at headwater springs and streams, leading to the absence of the coldest water during low flow periods (NMFS 2014). This broad scale degradation of habitats has likely increased the extinction risk of salmonids similar to conclusions reached by Nickelson and Lawson (1997) and Reeves *et al.* (1995). In general, across the action area, stream habitat has been simplified as a result of numerous factors. Salmonid populations in the action area are faced with less rearing habitat and poorer quality spawning habitat than likely occurred prior to these impacts.

2.4 Effects of the Action

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

2.4.1 Effects to Individuals

2.4.1.1 Potential Effects

Potential impacts from gravel mining on habitat are well documented (*e.g.,* Brown *et al.* 1998, Pauley *et al.*1989). Gravel mining modifies the geomorphic features and flow hydraulics at a bar-unit, and impacts cascade to a larger reach scale. This changes local salmonid habitat quality and quantity, potentially affecting individual NC steelhead, CC Chinook salmon, and SONCC coho salmon. For example, Brown *et al.* (1998) compared mined sites to reference reaches in gravel bed streams and found that total fish densities in pools were higher in reference reaches than in mined sites and reaches farther downstream. They also found bankfull channel widths were significantly increased at mined sites, and distance between riffles increased, resulting in fewer pools in reaches downstream of mined sites. Biomass and densities of invertebrates were higher in reference reaches. In addition, Pauley *et al.* (1989) observed changes in channel form and resultant impacts to habitat function from skimming, including: (1) decreased channel confinement, with widening and shallowing of the low flow channel and decreased water depths over riffles, which created migration barriers; (2) obliteration of side channels with complex habitat, resulting in reduced habitat for salmonids; and (3) channel instability at the top of skimmed bars, with an increase in the probability of redd scour. The likely impacts of the proposed action are discussed in detail in the sections below.

2.4.1.2 Exposure

Proposed gravel extraction operations within six river reaches expose several populations of listed SONCC coho salmon, CC Chinook salmon, and NC steelhead ("listed salmonids") to direct and indirect effects. Table 2-27 identifies relevant life stages exposed, by population and river reach. The six river reaches are: (1) Trinity River, (2) Lower Eel River, (3) Van Duzen River, (4) Middle Eel River, (5) South Fork Eel River, and (6) Isolated Sites. Isolated Sites include Fort Seward, PL Bar, Bear River and Mattole River. Fort Seward is located along the Eel River (within the Middle Eel River reach), and the PL Bar is located 16.7 miles up the Van Duzen River. Bear River and Mattole River are self-identifying.

Figure 2-12 depicts major exposure-response pathways that affect listed salmonids. In aggregation (collectively), conclusions regarding likely impacts consider multiple influences from alteration to key biological functions on each freshwater life stage of listed salmonids.

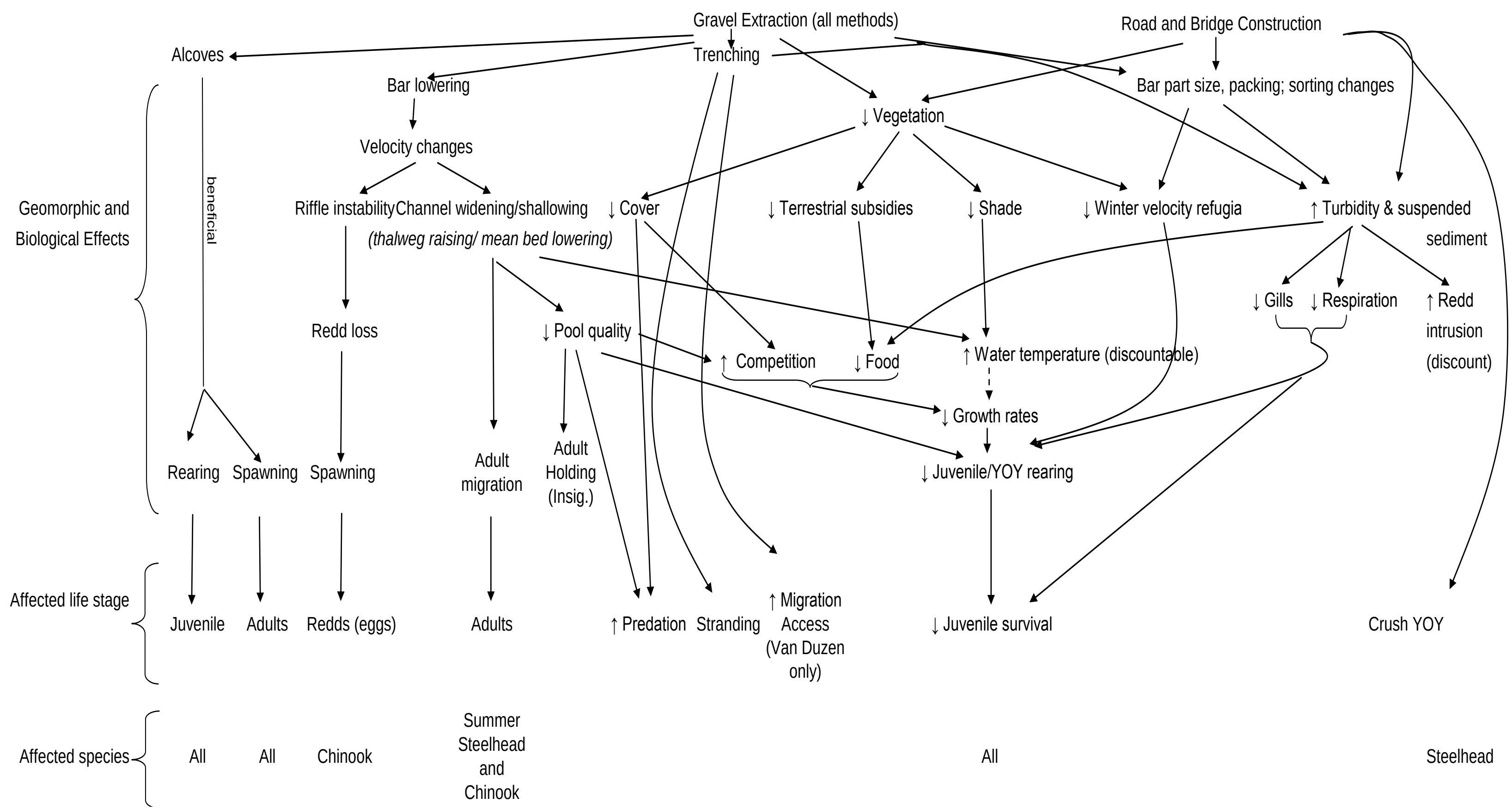

Figure 2-12. Major exposure-response pathways originating from gravel extraction and road and bridge construction related to US Army Corps of Engineers' Humboldt LOP 2015 and Hoopa Valley Tribe gravel mining proposal for 2015 to 2025. Large arrows indicate a primary pathway(s). Small arrows indicate an increase (pointing up) or decrease (pointing down) related to each geomorphic or biologic effect.

2.4.1.3 *Insignificant or Discountable Effects*

In-channel gravel extraction operations result in the following insignificant or discountable effects to listed salmonids and their habitats. These impacts include:
(1) dampened migration from temporary culvert use;
(2) noise, motion, and vibration disturbance from equipment operation;
(3) chemical contamination from equipment fluids;
(4) water heating due to less streamside vegetation and shade

2.4.1.3.1 ***Dampened Migration from Temporary Culvert Use***

Use of a temporary culvert, rather than a bridge (at sites where a crossing is proposed), can delay or eliminate fish passage. However, proposed temporary culverts will be sized to accommodate fish passage of all life stages relevant to a given location. In addition, culverts will be primarily employed to cross secondary channels, leaving the main channel completely unimpeded. Due to the aforementioned factors, usage of temporary culverts is expected to have insignificant effects on migratory timing of juvenile or adult salmonids.

2.4.1.3.2 ***Noise, Motion, and Vibration Disturbances from Heavy Equipment Operation***

Noise, motion, and vibration produced by heavy equipment operation within the vicinity of the wetted channel may disrupt migrating, spawning, or rearing salmonids at all gravel mining sites. Reports from Halligan (1997a, 1998, 1999) and Jensen (2000) indicate that gravel mining operations did not result in an observable response to migrating (holding) salmonids. There are likely sufficient pools and other cover for salmonids to seek refuge. The report also noted that no avoidance behaviors were exhibited during extraction operations which occurred as close as 45 feet to the stream and on bridges. Early-migrating adult Chinook salmon and steelhead seem to move continuously through the Trinity River, showing no apparent migration response due to exposure to gravel extraction operations (Jensen 2000). Any exposed listed salmonids are likely able to hold and migrate near active gravel extraction operations, despite noise, motion, and vibration, without a measurable negative response.

2.4.1.3.3 ***Chemical Contamination from Equipment Fluids***

All operations use equipment powered by diesel fuel and lubricated by other petroleum products that are hazardous to listed salmonids. There is potential for spill of these types of hazardous fluids, both in the water and on the gravel bar. Due to daily inspection of equipment for any leaks and proposed spill containment measures, only small amounts of hazardous fluids are likely to leak, or be delivered to the wetted channel. Due to the small amount, coupled with dilution factors, any effects from chemical leaks are expected to be insignificant.

2.4.1.3.4 ***Water Heating Due to Less Streamside Vegetation and Shade***

Vegetation removal, or suppression, resulting from gravel extraction and road construction, will likely reduce the amount of streamside vegetation and shade, resulting in a commensurate increase in water heating at select sites and corresponding river reaches. Increased water temperature is a concern because salmon and steelhead prefer cold water (less than about 15^{o}C). Water temperature influences juvenile steelhead growth rates, swimming ability, ability to capture and metabolize food, and disease resistance (Barnhart 1986, Bjornn and Reiser 1991). Upper lethal temperature limits generally range in the vicinity of 23 to 25^{o}C, although many salmonid species can survive short-term exposures to temperatures as high as 27 to 28^{o}C (Lee and Rinne 1980). Diurnal episodes of favorable water temperature can help salmonids survive periods of unfavorable temperature (Busby *et al.* 1996). Deep, cool pools, springs, and cool tributary inflow can also provide refuge (Nielsen *et al.* 1994).

Riparian vegetation protects stream temperature from rising by providing canopy that shades the water and reduces direct solar radiation reaching the water surface (Beschta 1991, Hetrick *et al.* 1998), and lessens the air-water temperature differential near the water surface. Stream temperature is also influenced by ambient air temperature, which is affected by season, latitude, elevation, topography, orientation, and local climate (Spence *et al.* 1996).

Water temperature in large, wide, streams is less buffered by the relatively small proportion of vegetative shading along the margin; and the influence of heat energy transfer is also diminished as stream flows increase (Beschta *et al.* 1987). However, temperature modeling conducted by Stillwater Sciences (2001) showed that the Russian River is well below the channel width threshold that would nullify the temperature mitigating influence of riparian vegetation, indicating that thermal buffering is at play in the action area. The Stillwater Sciences (2001) indicates that a channel width roughly seven times greater than tree (or riparian vegetation) height is needed before changes to thermal buffering become insignificant.

Minimal bar skimming, and head-of-bar buffers will likely detour any measurable increase in width of the low-flow channel. Additionally, water temperature in portions of the Lower Eel River, Bear River, and Mattole River reaches are likely moderated by a cooler coastal climate. Jensen (2000) showed that the lower reaches of the Eel and Van Duzen Rivers cool as they approached the Pacific Ocean.

Summer water temperature in all river reaches often approach the high end of tolerance for listed salmonids. Minute changes to temperature as a result of gravel mining and vegetation removal have the potential to exacerbate conditions. Despite gravel extraction, Jensen (2000) showed that pool area has remained fairly constant between 2005 and 2008. Although gravel extraction may result in some degree of pool filling close to extraction sites due to channel widening, minimal bar skimming, relative low volume of extraction, and head-of-bar buffers that control channel steering will likely marginalize any reduction in the overall amount of available cold water refuge at the reach scale, such as deep pools and cool-water seeps found by Jensen (2000) in the South Fork Eel River reach. Alternative extraction techniques such as dry, wet, and alcove trenching, and wetland pits reduces the risk of channel migration away from bedrock control, further reducing loss of cold-water refuge that would likely be lost during lateral channel movement.

Considering the factors discussed, detectable changes in water temperature or cool-water refuge are not anticipated.

2.4.1.4 Effects Not Insignificant or Discountable

In-channel gravel extraction operations result in the following effects that are not insignificant or discountable to listed salmonids and their habitats. These impacts include:
(1) crushing from in-stream equipment operation during bridge installation and removal;
(2) accelerated predation resulting from trenches;
(3) elevated stranding in excavation features;
(4) elevated turbidity and sedimentation from road Construction, and bridge installation and removal;
(5) bar lowering and channel widening, increased riffle instability, and reduced vegetation; and
(6) loss of refuge from high water velocity.

Refer to Table 2-20 for a summary of these effects to listed salmonids, by ESU/DPS and population.

2.4.1.4.1 ***Crushing from In-Stream Equipment Operation During Bridge Installation and Removal***

Temporary crossings, and limited in-stream equipment operation, is proposed within all reaches between July 1 and October 1 each year. Nearly all YOY Chinook salmon would likely avoid exposure because equipment will only operate during the trailing fringe of their outmigration period. However, a small number of YOY NC steelhead that might be present within the immediate vicinity would likely be exposed and potentially crushed, buried, or otherwise injured by equipment. Based on the most recent 10-year record, most temporary crossings are not installed until after August, when the presence of outmigrant life stages of any species is unlikely. YOY steelhead are only expected at a portion of the sites, in particular the Van Duzen, South Fork Eel, and Upper/Middle Eel River sites. However, based on the previous 10-year record of mining activity, most of these sites are not mined frequently. Furthermore, temporary crossings are rarely used at the sites with the highest likelihood of YOY steelhead. We expect exposure of only a few YOY steelhead each year, with a low likelihood of injury or mortality based on the average timing of crossing installation. Juvenile SONCC coho salmon, juvenile NC steelhead, and adult listed salmonids will be of sufficient size and maturity, to successfully flee and avoid death or injury. Redds are not likely trampled by equipment due to placement of crossings away from spawning habitat, and unlikely incidence of redds.

2.4.1.4.2 ***Accelerated Predation Resulting from Trenches***

Trenches have the potential to attract migrating adults for holding opportunities during fall migration, as well as rearing juveniles during the summer and fall, and entrap them as flows drop in the event that trenches become disconnected. Operators are expected to monitor trenches to ensure that the trenches remain connected to the mainstem rivers, to prevent entrapment and allow for passage into and out of the trenches. If the newly excavated trenches do not provide cover and hiding opportunities, then a potential increase in predation of juveniles would be expected, as well as the potential for an increase in susceptibility to poaching of adults. Vegetative cover must be provided within the trench in the form of placing woody debris within the excavated trench in order to reduce predation, and the pre-extraction mining plan will identify the cover that will be associated with the proposed trench. If these measures are implemented, predation will likely only accelerate a small amount, and since trenching is likely infrequent, the extent of predation will probably be minimal.

2.4.1.4.3 ***Stranding***

Gravel extraction surfaces (*i.e.*, skimmed bars, trenches, horseshoe skims, alcoves and wetland pits) all have an increased potential for salmonid stranding after inundation and subsequent receding flows where skimmed bars are left with closed undulations or depressions. The risk of stranding on skimmed bars is low due to post-extraction free draining grade. Skimmed bars must be final graded to provide a free draining surface as a way to avoid or minimize stranding. The risk of stranding is highest in wetland pits, and the stranding risk is dependant on the location. Wetland pits located on the 2 to 5 year floodplain are inundated intermittently during large flow events, about every 2 to 5 years. Based on the previous ten year record of mining activities, wetland pits are not a commonly used technique (the most recent wetland pit was excavated in 2011). . Trenches have a low likelihood of stranding fish based on the required inspections to ensure that trenches remain connected to mainstem rivers to accommodate fish passage into and out of trenches. Although trenches are designed to facilitate adult fish passage and avoid stranding, adult and juvenile listed salmonids could become trapped when shifts in channel form occur and unexpectedly close off the trench, and subsequent stream flows are insufficient to re-open the trench to salmonid migration. Trenches constructed at the confluence of the Van Duzen River and Eel River enhances adult salmonid migration and deepens holding and staging habitat for adult salmon. Trenches constructed by HVT will have woody debris and other elements of cover added. Furthermore, all trenches will likely be constructed to prevent premature adult migration by preserving existing riffle crest depths and pre-project passage conditions.

2.4.1.4.4 ***Elevated Turbidity and Sediment from Gravel Extraction, Road Construction, and Bridge Installation and Removal***

Gravel extraction, and road and bridge construction, loosens surface material, increasing erosion of bars and banks and elevating turbidity and sedimentation when disturbed areas become inundated. Increased turbidity and sedimentation will likely interfere with respiration, reduce feeding success, and displace any listed salmonids present. Increased sedimentation reduces the interstitial spaces of substrate, and decreases the habitable area for aquatic invertebrates, an important food source for juvenile salmonids (Bjornn *et al.* 1974, Bjornn *et al.* 1977). In-stream equipment operations and erosion of abutments located within the wetted channel are likely to cause short-term increases in turbidity during periods of low flow.

Elevated turbidity or sediment likely reduces benthic macro-invertebrate communities (food) by reducing primary productivity, thereby hindering feeding opportunity for exposed juvenile listed salmonids. Suspended sediment would likely deposit on any redds immediately downstream, suffocating incubating eggs or embryos. Wickett (1954) showed that sediment intrusion is most damaging to young embryos in the first 30 days of incubation because this stage is less efficient at oxygen uptake. Chinook salmon typically spawn in mainstem streams from November through January. The first winter storm events that wash over mined bars are likely to occur at the peak of the Chinook salmon spawning. Besides inhibiting the emergence of alevins, one of the principal means by which fine sediment reduces survival of salmonid embryos is by reducing intra-gravel water flow, thereby reducing the amount of dissolved oxygen available for respiration (Bjornn and Reiser 1991). Temporary sedimentation episodes, as anticipated, can exceed the ability of embryos to cope with such conditions (Alderice *et al.* 1958).

Suspended material increases turbidity, making salmonid prey and predator detection difficult. A minimum skim floor elevation at the 35 percent exceedence flow will provide confinement of the low flow channel until the stream begins to transport fine sediment. Timing of sediment increases can be critical for impacts to spawning and migration during the fall and early winter. The 35 percent exceedence flow is roughly the average daily flow, and signifies suspension and movement of fine bed load material (NMFS 2002). Increased turbidity and sedimentation as a result of extraction activities are expected to be of short duration (up to one day) and will occur during the first larger precipitation events of the season, when backgrounds levels of turbidity and suspended sediments will be naturally high. Salmonids in the Eel River have evolved in the context of high sediment loads, and NMFS expects that project-related sediment and turbidity will not interfere with respiration, reduce feeding success, or displace listed salmonids in the action area.

Channel crossing construction and removal methods employ measures aimed to minimize the amount of fine sediment delivery and associated turbidity, as well as avoid spawning habitat. Other methods that would provide equal or greater protection may be used as a substitute. As previously discussed, most temporary crossings will not be installed until August or later, thus avoiding all sensitive or immobile life stages such as eggs, embryos, or YOY.

2.4.1.4.5 ***Degradation, Channel Widening, Increased Riffle Instability, and Reduced Vegetation***

Gravel extraction removes gravel from the surface of river bars, potentially resulting in: (a) lowering the bar elevation (degradation), (b) channel widening, (c) riffle instability, and (c) vegetation loss.

<u>Degradation (Bar Lowering)</u>

Gravel (sediment) removal can result in localized or reach-scale bed degradation. Over time, stream channels adjust towards equilibrium between the sediment load and dominant sediment transporting flows. A gradual migration of the channel by eroding the outside of bends and depositing equal volumes on the inside of bends creates the dynamic equilibrium condition where the bed and banks are not net sources of sediment. Therefore, the equilibrium stream channel is efficient at maintaining its geomorphic form and pattern, although the system remains dynamic as it responds to cyclic floods and sediment delivery events. Dunne *et al.* (1981) stated that “bars are temporary storage sites through which sand and gravel pass, most bars are in approximate equilibrium so that the influx and downstream transport of material are equal when averaged over a number of years. If all the sand and gravel reaching such a bar is removed, the supply to bars downstream will diminish. Because sand and gravel will continue to be transported from these downstream bars by the river, their size will decrease.”

If stream bed lowering increases bank heights to the degree that banks become unstable, rapid bank retreat may occur, further destabilizing the width but supplying the channel with sediments that make good the transport-supply imbalance, to prevent further degradation until they are flushed out (Knighton 1984, Little *et al.* 1981). Thus, sediment removal from a relatively confined reach can trigger erosion migrating upstream, causing erosion of the bed and banks, which increases sediment delivery to the site of original sediment removal. Channel morphology is simplified as a result of degradation following sediment removal (Church *et al.* 2001). Also, Simon and Hupp (1992) show there is a positive correlation between bed lowering and channel widening, or bank retreat. As discussed above, channel widening can simplify salmonid habitats (Collins and Dunne 1990) and increase bank erosion, which can deliver sediment to downstream sites (Olson 2000), reducing pool quality.

Increases in width and bed degradation due to sediment removal are related. Where extraction occurs in excess of rates of natural replenishment, bars become smaller, the channel widens or the bed elevation lowers (degradation). The specific response depends on the confinement of the river, the volume of extraction relative to natural replenishment rates, and the methods of extraction. Where the river is confined, changes would occur in the form of bed lowering and decreases in bar size. Where the channel is unconfined, changes in all three aspects of channel form are likely. Note, all these changes in channel form lead to similar effects on pool habitat - simplification and reduction in overall quantity and quality.

Excavating an average volume that is equivalent to or exceeding the average deposited volume causes channel enlargement. The enlargement can be in the form of channel widening, lowering, or both. A sediment budget is analogous to a bank account. If the volume of sediment extracted and the natural export exceeds sediment input, a negative budget results. The deficit is made up by erosion of sediment from the bed and banks, resulting in bed degradation or channel widening. Annual sediment replenishment at a particular bar or reach is highly variable. Years with high intensity, long duration, storms recruit significantly more volume than a low intensity water year. This can result in natural aggradation of the channel in the extraction reach during a high flow year and a natural enlargement of the channel during low flow years. The variability is difficult to quantify but when more sediment is extracted than is recruited on average, an overall sediment deficit will occur. Over time, the result will appear as channel enlargement as the deficit is made up by the sediment stored in the banks and bed of the channel.

The effects of the action, particularly in reaches where multiple excavations occur, may cause bank erosion and bed lowering near the excavation sites, particularly if extraction rates exceed natural replenishment (Simon and Hupp 1992). This bed lowering, as discussed above, can promote continued simplification of in-stream habitat elements as habitat-forming bars are decreased. The effects of bed degradation on individual river reaches, where applicable, will be discussed in the reach-specific sections that follow.

Degradation: Lower Eel River, Van Duzen River, Middle Eel River, South Fork Eel River, and Isolated Sites

While past extraction rates have likely contributed to channel degradation for the period of 1968 to 1998 in some locations (Corps 1999), the flood of 1964 has certainly influenced the observed channel response. Since the implementation of the CHERT program, degradation is much less likely to occur than prior to the program. Channel degradation is not evident in the South Fork Eel River, Middle Eel River, or the Isolated Sites reaches.

Extraction within the South Fork Eel River is not likely excessive (annual extraction less than replenishment). Although mean annual recruitment for the South Fork Eel has not been determined, the relative scale of extraction compared to the large size of the basin and estimated related transport capacity supports this conclusion. The South Fork Eel River is likely resistant to channel instability because the channel is somewhat confined, and contains ample bedrock that provides control over channel morphology.

CHERT (2009) concluded there was an overall degradation in the Middle Eel River reach although, no large scale persistent effects from gravel mining occurred in relation to thalweg elevation, channel thalweg elevations, average bed elevations, or scour within the Middle Fork. A more thorough analysis completed by HRC (2009) shows that mean bed elevation for most bars has increased up to 1.2 feet between 1999 and 2008. The average increase was 0.5 ft. The pattern of this increasing bed elevation has been continuous but most pronounced since 2003 when very little extraction was occurred.

Expect extraction at the Lower Eel River, Van Duzen River, and Isolated Sites to lead to limited degradation of the bed to such an extent that reach-scale impacts to habitat will not occur. Planned extraction rates from 2015 to 2025 will presumably be less than, or similar to those recommended from 2004-2014. Skimming will occur away from riffles which provide critical channel control, and will be limited in extent relative to the overall bar size.

Degradation: Trinity River

Gravel extraction at the Trinity River sites is not expected to result in measurable changes in pool depth or extent or noticeably alter the morphology of the river such that coho salmon habitat will be simplified in the low flow channel. This is primarily because the channel forming element is bedrock and the channel is confined. In addition, the sites are relatively dispersed and gravel extraction amounts are low so no reach level cumulative effects of gravel extraction are expected.

<u>Channel Widening</u>

Stream channels in sediment removal areas typically become progressively wider as the channel is less stable. Overall, salmonid habitat is reduced in unstable channels (*e.g.*, Newport and Moyer 1974, Behnke 1990, Kanehl and Lyons 1992, Hartfield 1993, Waters 1995, Brown *et al.* 1998) and the associated riparian habitat deteriorates (Rivier and Seguier 1985, Sandecki 1989). Effects on salmonid habitat include reduced pool depth and complexity, decreased riffle quality and less influence from streamside vegetation in the form of instream cover and shade.

Removal of sediment from the active channel alters the natural channel configuration. The width-to-depth (W/D) of the channel is one reflection of the topographic relief along a given cross-section. We expect sediment removal from bars to create a wider, more uniform channel cross section with less lateral variation in depth, and reduced prominence of the pool-riffle sequence in the longitudinal profile (Collins and Dunne 1990, Church *et al.* 2001). For example, where bars are skimmed, we expect a more rectangular channel is created with a wider and shallower cross section. This will result in a change in the sediment transport regime indirectly influencing habitat by removing the steering effect provided by the bar and simplifying the velocity distribution, therefore lessening the hydraulic controls on pool and riffle formation and maintenance. In this instance, pools will become shallower, or disappear altogether as more uniform, flatwater habitat forms. Riffle crests will become less pronounced and substrate quality will degrade due to the reduced sediment sorting ability provided by the adjacent bar. This is consistent with observations by Church *et al.* (2001), who note simplified channel morphology as a result of reductions in topographic complexity following sediment removal. We note that these changes are both instantaneous, as a direct result of sediment removal from a site, as well as chronic when bars are repeatedly mined and natural bar recovery is inhibited.

Where multiple, sequential bars are lowered or removed, a reach-scale effect also occurs. In this instance, the removal of sediment from multiple bars over a reach creates a channelized condition where former topographic roughness elements in the channel (*e.g,*. bars) are reduced or eliminated. In this instance, habitats may be simplified over a much greater length than single pool-riffle sequences adjacent to a given bar as the reach-scale hydraulic and sediment transport characteristics are changed. Therefore, we note two processes by which stream habitat may become simplified – site-specific adjustments of the channel associated with a particular extraction site, and reach-scale changes in channel morphology as a cumulative effect of multiple extraction sites. Unfortunately, no longer-term habitat data are available to assess the degree to which these effects have occurred in the action area.

Changes in the channel width should be considered in the appropriate spatial scale with respect to water elevation as well. The relevant spatial scale is both the low-flow channel and the high-flow channel. Potential changes in the high-flow configuration may be constrained by resistant valley walls, such as on portions of the Trinity River where there is a limit to the amount of channel widening that may occur. Conversely, channels in wide, alluvial valleys, such as portions of the Eel River, are relatively less constrained and have the potential to affect larger areas as the channel is free to migrate via bank erosion. Therefore, changes in the high-flow channel dimensions would cause changes in habitat at the larger reach scale. Multiple habitat elements would be affected by the changing channel configuration in these settings. This is in contrast to changes in the low flow width where increases would be more confined to individual habitat elements. Thus, repeated sediment removal at a site has the potential to affect habitat at both the reach and site scales depending on the overall confinement of the channel in the valley.

Several measures will reduce the potential effects cited above. These include: 35% exceedence flow elevations used as the minimum skim floor elevation, head-of-bar buffer, maximum width of skims, and prioritizing alternative extraction techniques.

The minimum head-of-bar buffer is defined in LOP 2015 as that portion of the bar that extends from at least the upper third of the bar to the upstream end of the bar that is exposed at summer low flow. The intent of the buffer is to provide protection of the natural stream flow steering effect provided by an undisturbed bar. The head-of-bar buffer will minimize the potential for geomorphic changes to the river from sediment extraction. With the head of bar buffer, we expect that extraction will not promote channel shifting and potential widening. For example, in the absence of a buffer, the channel would be free to shift position across the previous bar feature and possibly assume a braided or very wide and shallow configuration.

Limiting the extent of the skim width is expected to serve two purposes. First, it reduces the area over which extraction may occur and therefore lessens the immediate changes in channel width. Second, the narrow skims proposed by the applicant will better conform to the overall river planform and readily replenish on frequent storm flows.

Avoiding the higher portions of the bar will retain the larger scale topographic features of the bar that provide hydraulic control during the larger storm flows. In the absence of these high points serving as elevation controls, similar to the influence provided by the head of bar, we would expect the channel to be subject to greater lateral instability and channel widening.

Channel Widening: Lower Eel River, Van Duzen River, Middle Eel River, South Fork Eel River, and Isolated Sites

The Lower Eel River and Van Duzen River reaches are the most sensitive to increased widening. Habitat conditions in these reaches are dominated by relatively shallow pools and poorly pronounced riffle crests. Dominating shallow “flatwater” habitat provides poor conditions for juvenile rearing. Most of the higher quality pools within all river reaches appear to occur when the low flow channel is associated with bedrock outcrops and other resistant features along the valley margins as well as scour along infrequently flooded alluvial terraces and higher bars within the active channel.

The lower Eel River is a wide channel with some channel braiding, which maybe have been exacerbated by past gravel extraction. Some of the channel braiding may be a consequence of the channel slope in this reach. Halligan (1996) considered the lower Eel River to be more simplified and homogeneous in comparison to other Humboldt County rivers. Alternative extraction techniques rather than traditional skimming will be used in this reach and will minimize further increases in the low-flow channel width.

Where traditional skimming may occur in the upper portion of the Van Duzen River reach, we expect gravel extraction will likely add to poor habitat conditions by inhibiting the development of suitable quality pools for holding, sheltering and rearing. The result is most acute near the mouth of the Van Duzen River where shallow, braided conditions resulted in the stranding of adult Chinook salmon in both 1996 and 2001 (NMFS 2002c). Lateral instability at the mouth, fostered by the increased low-flow channel width, largely precludes the formation of deeper water holding habitat. Since the proposed action limits skims to no wider than 90 feet along the Van Duzen River, we do not expect adverse effects associated with channel widening and lateral instability. Furthermore, avoiding wide, traditional skims will allow for bar height recovery and promote better migratory conditions for adult salmonids.

Generally, the proposed mining sites are relatively dispersed and of relatively low mining intensity. Additionally, site-specific provisions are proposed, including skims no wider than 90 feet along the Van Duzen River to minimize channel widening, head-of-bar buffers and minimum skim floor elevations. Because of these considerations, we believe there will be no adverse effects to salmonids as a result of channel widening for the Lower Eel River, Van Duzen River, Middle Eel River, Trinity River, and Isolated sites.

Past skimming has likely exacerbated channel widening in the South Fork Eel River by not allowing sufficient bar height recovery to allow for low flow channel confinement. Continued skimming within the South Fork Eel River will likely perpetuate the lack of adult holding and juvenile rearing habitat in the absence of sufficient bar height recovery. We expect this effect will be minimized by protecting the upper portion of the bar and implementation of alternative extraction designs (*e.g.*, trenching), as proposed. We expect the proposed action will cause reductions in deeper water juvenile rearing habitat near the extraction sites along the South Fork Eel River. This will result in increased competition among individual steelhead juveniles, which to be the primary salmonid species present during the summer. As a result, affected individuals near the extraction sites may experience adverse effects in the form of reduced growth rates.

Channel Widening: Trinity River

Because of the confined nature of the Trinity River, the dispersed nature of the mining sites, and the relatively low amount of material that is expected to be removed from the Trinity River at each site that, in total, is well below the estimated mean annual recruitment (*i.e.*, 250,000 cubic yards), NMFS does not anticipate that any measurable channel widening will occur in response to either proposed action.

Vegetation Loss

Pool quality in some portions of the action area is strongly influenced by the presence of riparian vegetation (Halligan 2003). Pool quality in the Trinity River is not measurably influenced by riparian vegetation. Riparian vegetation provides bank stability, which may locally resist scour and form deeper pools. Overhanging vegetation and vegetation that is recruited directly into the channel provide an important cover element for salmonids. Annual bar skimming removes riparian vegetation that would otherwise colonize a portion of gravel bar surfaces. Extraction sites also increase vehicular access, resulting in increased removal of woody debris. In the stream reaches that are not confined by levees or naturally resistant boundaries, long-term or repeated modification of gravel bars at low elevations promotes frequent channel shifting that precludes the establishment of riparian vegetation to provide habitat complexity. As discussed above, stream channels in the action area can be expected to become progressively wider and less stable with consequent deterioration of adjacent riparian habitat (Rivier and Seguier 1985, Sandecki 1989). Where sediment removal exceeds sediment input, resulting in channel degradation, the water table may decline, further reducing the ability of riparian vegetation to become established or survive on bar surfaces.

Mature vegetation provides additional benefits to juvenile salmonids in the form of physical structure. Structure in the form of LWD, when recruited into the active channel promotes localized scour, pool formation and is, itself, utilized as cover. Cover is also provided to juvenile salmonids by overhanging vegetation, submerged vegetation, and exposed roots. The cover provided by complexities in structure can increase survival rates for rearing salmonids in summer and winter, and as outmigrating smolts (Meehan 1991).

Ecological energy is typically derived from detritus in streams (Cummins *et al.* 1973, Vannote *et al.* 1980) and is processed by different organisms (Anderson and Sedell 1979) in a continuum from larger to smaller particles (Boling *et al.* 1975). Riparian vegetation provides important nutrient inputs to streams such as leaf litter (Cummins *et al.* 1973) and terrestrial invertebrates that drop into the stream. Such allochthonous inputs can serve as the principal source of energy for higher trophic levels in stream ecosystems (Reid 1961, Gregory *et al.* 1991). Leaf litter provides the trophic base for aquatic macro-invertebrate communities that in turn are the fundamental food source for salmonids (Hawkins *et al.* 1982, Beschta 1991, Bretscko and Moser 1993).

Decreases in pool quality and quantity will impact adult holding by both reducing the ability of pools to provide for cool water and cover, and by an overall reduction in the number of pools available for holding. Decreases in pool quality and quantity will also reduce juvenile rearing success through decreases in the overall amount of habitat available, and reductions in available food base and cover. Juvenile salmonids are morphologically, behaviorally and ecologically different, which result in differential interspecific exploitation of riverine habitats (*e.g.*, pools; Bisson *et al.* 1988). For example, coho salmon are dorso-laterally compressed and have larger fins, which enables maneuverability in slower velocity pool habitats (Bisson *et al.* 1988). Steelhead trout are more cylindrically-shaped and have smaller fins, which enables utilization of higher velocity habitats such as riffles and runs (Bisson *et al.* 1988). These morphological differences demonstrate one reason why coho salmon are found in pools and steelhead are typically found in higher velocity habitats. Coho salmon out-compete juvenile steelhead for preferred pool habitats, but are unable to compete with steelhead in higher velocity habitats (Hartmann 1965). If pool quality and quantity declines, competitive interactions between coho salmon and steelhead will increase and steelhead will gain a competitive advantage. Increased overlap between steelhead and coho salmon in habitats where steelhead hold a competitive advantage is likely to result in decreased growth of coho salmon (Harvey and Nakamoto 1996), which can affect size of smolts and subsequent smolt- to-adult survival (Ward and Slaney 1988, Holtby *et al.* 1990).

LOP 2015 and the HVT proposed action requires that disturbance of woody riparian vegetation that is part of a 1/8 acre contiguous complex be avoided LOP 2015 and the HVT proposed action does not require that LWD found on the gravel bar be stockpiled and replaced after extraction, nor does the proposed LOP require the protection of newly emergent, or potentially emergent riparian vegetation. However, the CHERT process and the HVT review process does take protection of existing riparian vegetation into account during the review and recommendation of mining plans, and the LOP does require that educational signing regarding the importance of LWD for salmonids be placed at access roads owned, controlled or utilized by the gravel operators. We expect that gravel mining, as authorized under LOP 2015, will maintain, the current condition of riparian vegetation and LWD function.

Elimination of LWD and LWD sources has likely contributed to the paucity of pool habitat complexity along many of the reaches including the lower Eel, South Fork Eel, and the Van Duzen. Because the proposed action will minimize the use of traditional skimming in lieu of alternative techniques and provide for a head-of-bar buffer, NMFS anticipates the above described effects will be minimized. Additionally, bedrock controls along the South Fork Eel and Middle Eel River reaches help protect pool form and function. Therefore, we expect measures provided for in LOP 2015 will minimize the effects associated with altered riparian function on salmonids. Where localized reductions in riparian vegetation occur in the Lower Eel River reach, we expect that salmonids will be able to relocate to other suitable unoccupied areas, given the low densities of salmonids in the reach.

In the Van Duzen River reach, high densities of juvenile salmonids rear and depend on complex habitat for cover and food inputs. Because of the wide channel and associated instability in the lower Van Duzen River, frequent lateral shifts in the channel will continually erode young vegetation and reduce the amount of future habitat afforded by riparian vegetation colonization. Aerial photos reveal that riparian vegetation provides only transient habitat complexity, yet these short-lived habitat features are important areas for salmonid rearing and holding. Frequent channel migration erodes currently functioning vegetation while providing new surfaces for colonization. The effect of gravel extraction, particularly skimming, will suppress riparian succession at the individual mining sites. Where a site is repeatedly skimmed, the effect is a chronic reduction in the quantity of vegetation. Therefore, on average, we expect a lesser extent of riparian vegetation in the immediate vicinity of the extraction sites where skimming occurs. Skim width limitations on the Van Duzen River limit the extent of mining and promote the development of riparian vegetation.

Riparian vegetation is generally not found on the Trinity River bars or is extremely limited where extraction occurs because of the confined nature of the channel and consequent scouring at high flows. Where vegetation does occur, past extraction has avoided those areas and those practices are expected to continue.

<u>Increased Riffle Instability</u>

Riffle instability from gravel mining affects spawning, migrating, and rearing habitat for listed salmonids.

Riffle Instability: Impacts to Spawning Habitat

Similar to decreases in pool quality, sediment removal also initiates channel instability that has consequence on the stability and quality of riffle habitats. Sediment removal, particularly in-stream trenching, can cause bed lowering to propagate both upstream and downstream, thereby scouring spawning substrate or redds. Increased channel instability, either through degradation or lateral migration, increases the risk that salmonid redds will be destroyed. For example, the loss of egg inoculated gravel from riffles was documented by Pauley *et al.* (1989), who concluded the eggs were scoured because bar skimming reduced bar heights, increasing shear stress over riffles. Where flow diverges over riffles, the flow depth and velocity-field become more uniform, providing conditions conducive to the formation of well sorted patches of gravel. It is these gravel patches, combined with the gradient of the hyporheic flow field (subsurface water), which provide optimal substrates for spawning salmonids (Groot and Margolis 1991). Where habitat is simplified and the pool-riffle sequence is less pronounced, as noted by Collins and Dunne (1990), spawning habitat quantity and quality will be reduced. Sediment extraction at a site has also been demonstrated to reduce the overall substrate size. Therefore, where larger particles are in short supply, extraction at a site would likely reduce the quality of spawning habitat by reducing the size of spawning substrate needed for listed salmonids, particularly Chinook salmon. Decreased particle size due to sediment removal activities would both lead to increased bed mobility and a higher likelihood of redd scour.

The Lower Eel River reach does not provide quality habitat for Chinook salmon spawning, and is not used by coho salmon or steelhead for spawning. Where potential spawning may occur, head-of-bar buffers and minimization of skimming will minimize the effects on spawning habitat.

The South Fork Eel River and Van Duzen River provide spawning habitat to Chinook salmon, with increased usage in low flow years. The extent of coho spawning in these reaches is unknown, but expected to be limited because they are not mainstem spawners. The Van Duzen River is particularly sensitive to instability, while the South Fork Eel is rather resilient to instability due to its morphology and bedrock control. Expect that gravel extraction will slightly increase the frequency at which channel migration occurs in the extraction reach, thereby further reducing spawning habitat conditions. Skimming by promoting lateral instability and increased scour as the flow path is shortened over the bar, and trenching by increasing channel down cutting which could scour redds as the channel locally readjusts to accommodate the trench site. For all extraction techniques, NMFS expects a general decrease in substrate size temporarily as finer materials accumulate. These finer materials will mobilize in the future as larger particles are recruited over time.

Design features provided in LOP 2015, including minimum skim floor elevations, minimization of skimming, and the head-of-bar buffer will reduce the probability of increased lateral channel migration and scour. However, these measures will not entirely avoid impacts. NMFS anticipates a portion of Chinook salmon redds being destroyed or experience reduced emergence as a result of adjacent extraction and consequent changes in the scour and depositional environment due to changes in channel location. The extent or probability of redds being destroyed depends on the timing of hydrologic events relative to spawning timing. In the Middle Eel River, we expect a few redds per year would be affected based on the number of riffles that might be impacted and the limited use of these riffles for spawning. Likewise, on the Van Duzen River, a few redds per year would be adversely impacted as a result of adjacent extraction. These estimates are based on the assumption that approximately up to five spawning riffles each year will be impacted, and each riffle may have multiple, but limited, redds. Multiple redds per riffle are anticipated because of the paucity of spawning riffles or substrate in this reach and sufficient space to accommodate multiple redds.

Spawning habitat for coho salmon is not found in the action areas for either the LOP 2015 or the HVT's proposed action areas on the Trinity River.

Riffle Instability: Impacts to Rearing Habitat

The shallow, swift flows over riffles are also important habitats for numerous species of invertebrates, many of which are important food sources for salmonids. Reductions in the quality of riffles occur by a decrease in overall substrate size by chronic sediment removal (especially in locations with a high density of mining), resulting in changes and overall reductions in macro-invertebrates, thereby decreasing food availability for rearing juvenile salmonids. Decreased food availability will result in smaller juveniles. Decreased smolt size at the time of ocean entry has been shown to decrease ocean survival, and thus reduce the abundance of returning adults (Ward and Slaney 1988, Holtby *et al.* 1990). NMFS expects the provisions for head-of-bar buffer and minimum skim floor elevation (where skimming does occur) will minimize the likelihood of riffle instability and, therefore, minimize any impacts to rearing habitat.

Given the low densities of salmonids in the lower Eel River reach, individual salmonids are expected to successfully relocate to suitable nearby habitat should rearing habitat become unsuitable. Similarly, listed salmonids are expected to relocate within the Isolated Sites due to their small area and the infrequency of mining at the sites. Head-of-bar buffers limit the influence on riffles sufficiently at the Van Duzen River and Trinity River reaches and do not expect measureable decreases in the quality of rearing habitat at riffles.

At the South Fork Eel River reach, NMFS expects that juvenile steelhead rearing habitat will be locally reduced, increasing competitive pressures and decreasing growth rates of the affected individuals. Due to the low intensity of mining through the South Fork Eel River reach, we anticipate that only a small number of the riffles could be affected, and those riffles that are affected will continue to provide some level of functional habitat such that steelhead are still able to use the area. We expect these changes in habitat may increase competition at a given riffle and result in reduced growth rates for a portion of the juvenile steelhead using this riffle. However, the previous ten year record of habitat monitoring indicates that riffle habitats have been stable and resilient in the South Fork Eel River mining reach.

Riffle Instability: Impacts to Migration Habitat

Calculations of water surface elevation using cross sections available in mined areas indicate that the 35 percent exceedence flow provides for a water depth sufficient to allow for adult salmonid migration that is consistent with observations and recommendations for depths across a cross section that is consistent with Thompson (1972). Water depths for large salmon spawning have been noted between 6 and 14 inches (Meehan 1991). Most mainstem spawning occurs near riffles or at the pool tail just upstream of the riffle. Similarly, ten inches of water over the riffle crest in an undisturbed river should be sufficient to provide unimpeded fish passage. However, in disturbed channels, fish expend additional energy to migrate through simplified and reduced pool-riffle structures. Frequently disturbed rivers are often missing some of the important attributes of a natural river that allow unimpeded migration or spawning. Those attributes include channel margin complexity, bed roughness, and vegetative cover. Additional flow depth beyond the cited minimums can help offset the lack of habitat complexity.

Migration blockages may be created through two mechanisms. First, where a skim floor is taken down to the level of an adjacent riffle at low-flow, rising flows will not be confined. Therefore, during the first rising flows of the fall, river width would increase rapidly while depth would increase very little and the riffle continues to be a migration barrier. NMFS expects proposed extraction offsets and 35% exceedence skim floor elevation limits to allow for adequate low-flow confinement.

A second mechanism by which migration would be impeded is through longer-term increases in width due to repeated sediment removal at a site. As discussed previously, various sediment extraction methods can increase channel width at the site. Channel degradation has been accompanied by channel widening (Simon and Hupp 1992). This occurs as bars are lowered or removed, and stream habitat becomes less complex. The habitat simplification that occurs as a result of sediment removal produces a greater amount of habitat, with an overall decrease in topographic complexity. Adult migration may be impeded if long stretches of flat water habitat occur without holding cover (Thompson 1972).

Appreciable changes are not anticipated in riffle configurations in the South Fork Eel, Middle Eel, Trinity Rivers or Isolated Sites such that adult passage is impaired as a result of the proposed action. We expect the use of 35 percent exceedence flow minimum skim floor elevation coupled with the head-of-bar buffer and infrequent mining at the isolated sites and Middle Eel sites will provide for adequate migration by providing adequate water depths. Extractions on the Trinity River are not expected to alter the riffle configurations because the extractions include head of bar protections and the river morphology is controlled by bedrock such that the riffle pool sequences are generally maintained regardless of where and how gravel mining occurs.

Migration blockage is a significant concern in the lower Eel River and Van Duzen River reaches which are lower in the watershed. Shallow flatwater areas, shallow riffles, and presence of braided channels significantly impair upstream migration of Chinook salmon adults. Limited adult holding or staging habitat is another limiting factor in these reaches where often times thousands of adult fish are present in one pool. Extraction techniques to enhance adult holding habitat will also be encouraged.

We expect the minimum skim floor elevation corresponding to the 35 percent exceedence flow to provide for adequate depth. Additionally, we expect with the alternative extraction methods over traditional skimming on the Van Duzen and Eel River will minimize future instance of adult stranding in shallow stretches. The 90-foot maximum skim width and head of bar buffer will also provide for stability in the immediate vicinity of the extraction site. NMFS does not expect that the proposed action will result in migration blockages in the Van Duzen River or Lower Eel River due to riffle instability.

2.4.1.4.6 ***Loss of Refuge from High Water Velocity***

Sediment removal (*i.e.*, gravel extraction) can alter the distribution of velocity refugia in extraction reaches. These impacts occur through: (a) pools and channel complexity loss, (b) change in channel bed roughness, (c) reductions in riparian vegetation, and (d) increased velocity at high flow.

<u>Loss of Refuge from High Water Velocity: Pool and Channel Complexity Loss</u>

Pools provide a complex of deep, low water velocity areas, backwater eddies, and submerged structural elements that provide cover, winter holding, and flood refuge for fish (Brown and Moyle 1991). During their upstream migration, adult salmonids typically move quickly through rapids and pause for varying duration in deep holding pools (Briggs 1953, Ellis 1962, Hinch *et al.* 1996, Hinch and Bratty 2000). Holding pools provide listed salmonids with safe areas in which to rest when low flows or fatigue suppress migration. Pools are also preferred by juvenile coho salmon (Hartman 1965, McMahon 1983, Fausch 1986), the subset of Chinook salmon that over-summer, and steelhead. Steelhead also utilize riffle habitat if it is complex with velocity refuge behind cobble and small boulders (Hartman 1965, Raleigh *et al.* 1984, Hearn and Kynard 1986, Nielsen *et al.* 1994). Pools with sufficient depth and size can also moderate elevated water temperatures stressful to salmonids (Matthews *et al.* 1994). Deep, thermally stratified pools with low current velocities, or connection to cool groundwater, provide important cold water refugia for cold water fish such as salmonids (Nielsen *et al.* 1992).

Degradation, initially, creates a deeper, narrower channel. Back channels are cut off and river-edge wetlands are de-watered. Initially, complex channels tend to evolve into less complex channels with less expression of topographic complexity (*e.g.*, pool:riffle ratio). These effects amount to a reduction in habitat diversity (Lisle *et al.* 1993).

Pool and Channel Complexity Loss: Lower Eel River, Van Duzen River, and South Fork Eel River
Given the currently degraded state of habitat in the lower Eel River, South Fork Eel River and Van Duzen River, existing velocity refugia in the form of complex pools, off-channel habitat, and topographic complexity are limited. We expect that continued gravel extraction, in the absence of bar height recovery, will have the effect of maintaining this condition near the individual extraction sites. Based on the previous ten years of monitoring data, it appears that bar heights have recovered in many areas, which has also resulted in an increase in measured adult holding habitat (Stillwater 2015). Alternative extraction methods such as alcoves and trenching may provide short-term refuge sites as well.

Although narrow skims and alternative extraction techniques will likely be employed more than wide, traditional skims, gravel mining will maintain, or further simplify out migrating and rearing habitat, thereby limiting refuge opportunity from high water velocity. The Lower Eel River reach is particularly important for juvenile Chinook salmon in the late winter and early spring. Promoting continued maintenance of the current non-complex habitat conditions will likely reduce survival of individual listed juvenile Chinook salmon in the Lower Eel, Van Duzen, and South Fork Eel Rivers.

Pool and Channel Complexity Loss: Middle Eel River
Previous discussions on the effects to pool quality and riffle stability in the Middle Eel River suggest that there will be no significant changes in habitat elements, such as pools, that restrict the availability of velocity refuge provided by larger habitat features. In fact, alternative extraction methods (*i.e.*, alcoves, horseshoes, and trenches) at the downstream end of bars will likely offer temporary velocity refuge during moderately high flows.

Pool and Channel Complexity Loss: Trinity River
Gravel extraction at the Trinity River sites is not expected to result in measurable changes in pool depth or extent or noticeably alter the morphology of the river such that coho salmon habitat will be simplified in the low flow channel. This is primarily because the channel forming element is bedrock and the channel is confined. In addition, the sites are relatively dispersed and gravel extraction amounts are low so no reach level cumulative effects of gravel extraction are expected.

Loss of Refuge from High Water Velocity: Changes in Channel Bed Roughness

Reductions in exposed particle size result from the removal of overlying coarse sediments and abrasion and particle breakage caused by the passage of heavy equipment. Coastal watersheds in the action area are composed of sedimentary and low-grade metamorphic rocks. Particles that easily break into smaller particles when moving downstream and when heavy equipment crushes them dominate the coarse sediment load in these streams. As a result of disrupting the natural armoring process and mechanical crushing, disturbed bar surfaces are typically finer-grained than undisturbed bar surfaces.

Areas of heavy bed armor can provide valuable fish habitat during high flows (Church *et al.* 2001) because of low near-bed velocity and productive benthic habitat whenever inundated (Bjornn *et al.* 1977). Loss of pool quality discussed above is one manner in which important velocity refugia can be reduced or eliminated. In addition, riffles with course substrate such as cobble and small boulders provide velocity refuges for juvenile salmonids (Hartman 1965, Raleigh *et al.* 1984, Hearn and Kynard 1986, Nielsen *et al.* 1994). As described previously, sediment removal results in finer substrate sizes, resulting in increased bed mobility. Increased bed mobility will result in less stable velocity refugia.

Changes in Channel Bed Roughness: Lower Eel River, Van Duzen River Reach, and South Fork Eel River Reach

The characteristic particle size distribution along the Lower Eel River and Van Duzen River is largely dominated by gravel and cobble. The South Fork Eel River reach has gravel with both finer sediments such as pea gravel and sand, and coarser boulders (Jenson, 2000). Gravel extraction, particularly skimming, reduces the coarse armor layer, translating to localized reductions in high-flow velocity refugia.

Given the already small particle sizes present in the Lower Eel River, we do not expect the overall texture of the bed to change to such a degree that bar-scale reduction in velocity refugia are likely to occur. NMFS expects reductions in the coarse sediment fraction will result in insignificant and temporary reductions of velocity refuge.

Because of the proximity of Chinook salmon spawning to mining sites in the Van Duzen and the South Fork Eel Rivers, we expect that habitat for newly emergent fry in the form of bed roughness may be reduced when compared to un-mined conditions. Given the degraded condition of the existing habitat in the Van Duzen River and in the Lower Eel River, we expect this temporary reduction in habitat due to changes in roughness. We expect the effects in the Van Duzen and South Fork Eel will be localized and not lead to a detectable change in abundance.

Changes in Channel Bed Roughness: Trinity River Reach

Sediment removal in the Trinity River sites will remove the coarse armor layer that provides high flow velocity refuge to juvenile coho salmon. NMFS expects a small decrease in coho salmon production as the action will impair the ability of coho salmon to shelter from high flow events.

Changes in Channel Bed Roughness: Middle Eel River and Isolated Sites

With the spatial separation and infrequency of mining in the Middle Eel River and Isolated Sites, we expect reductions of rearing capacity in the reach to be minor and localized and will not adversely affect juvenile listed salmonids.

Loss of Refuge from High Water Velocity: Reduced Riparian Vegetation

Vegetative structure increases hydraulic boundary roughness, resulting in relatively lower velocities near the flow-substrate interface (Beschta and Platts 1986) and increases channel and habitat stability (Lisle 1986). These low velocity zones provide refuge habitat to salmonids during high-flow events. Many salmonids seek out low velocity areas close to high velocity areas in order to optimize foraging and maximize net energy gain (Fausch 1984).

Historic removal of streamside vegetation from timber harvest and development has largely reduced high flow velocity refugia from this source. Although the proposed action will avoid larger vegetation, continued channel instability suppress natural riparian succession and reduce the quantity of larger vegetation available for high flow shelter. When the frequency of inundation of riparian vegetation is reduced, the consequence is that salmonids have less access to the velocity refugia afforded by riparian vegetation than would otherwise occur in less degraded conditions.

Smaller patches of younger vegetation (*e.g.*, willows) in the active channel and along eroding alluvial banks will continue to provide valuable velocity refugia in addition to the pool complexity features discussed previously. However, lateral shifts in the channel will continually erode young vegetation and reduce the amount of velocity refuge afforded by riparian vegetation. Any increases in channel meander will reduce the overall age and size of vegetation able to provide velocity refugia. Based on the previous ten year record, the location of the thalweg has remained rather constant in most cases, suggesting that lateral shifts in the channel are not common.

Given the lack of larger vegetation, generally small particle sizes, and lack of complex habitats in the form of pools and off channel habitats, we expect that the smaller riparian vegetation located within the active channel provides one of the few velocity refuge habitats. Continued sediment extraction that promotes lateral channel migration may continue to limit the amount of this habitat available. Since some of the reaches are subject to extensive extraction, we expect the reduction in velocity refugia will have a temporary effect on salmonids utilizing the reach by displacing individuals to other areas.

Reduced Riparian Vegetation: Lower Eel River, Middle Eel River

We expect the vegetative velocity refugia to be most important for Chinook salmon fry. Because the proposed action will minimize skimming and implement a head-of-bar buffer as well as a minimum skim floor elevation (35% exceedence elevation), we expect the reductions in riparian vegetation to be isolated within the lower Eel River and, given the low density of salmonids present in the reach, individuals will be able to locate suitable unoccupied habitat elsewhere. Similarly, we expect velocity refuge afforded by vegetation in the Middle Eel River, and Isolated Sites will not be significantly impaired. In the isolated instances where vegetation colonization is precluded by mining, we expect that juvenile salmonids will find nearby suitable habitat.

Reduced Riparian Vegetation: Van Duzen River

Given the lack of larger vegetation, generally small particle sizes, and lack of complex habitats in the form of pools and off channel habitats in the Van Duzen River, we expect that the smaller riparian vegetation located within the active channel helps provide some velocity refuge in the mainstem Van Duzen River. Therefore, continued sediment extraction that promotes lateral channel migration will continue to reduce the amount of this habitat available. Because no wide skims will occur in the Van Duzen River and a head-of-bar buffer will be implemented where skimming does occur, we expect lateral instability will occur at rates near what would be expected in an unmined setting. The previous ten years of monitoring data also suggest that modern day mining practices have increased the lateral stability of extraction reaches. Salmonids, juvenile salmon in particular, will be affected by the lack of velocity refugia. In the

Van Duzen River portion of the action area, juveniles may be dislocated downstream where conditions are less favorable for rearing, particularly when flows subside in the summer and suitable rearing habitat is limited.

Reduced Riparian Vegetation: South Fork Eel River

In the South Fork Eel River, we expect the loss of velocity refugia to primarily affect newly emergent salmonid fry because fry are highly dependent upon edgewater and submerged riparian vegetation. Given the close proximity of Chinook salmon spawning, we expect a significant number of Chinook salmon fry will be present in the extraction reach early in the mining season, although it is important to note that most mining activity occurs after the outmigration of Chinook salmon fry. We also expect a smaller number of steelhead fry will be present in these areas, and coho salmon fry are expected to be rare. Given the limited availability of adequate habitat under the current habitat conditions, we conclude that any additional loss of velocity refuge will result in a concomitant decrease in salmonid fry survival, as these fish will be more readily swept downstream. We expect that many displaced fry will be able to locate suitable habitat downstream. The various site-specific measures will limit the influence of these effects on velocity refugia to more site-specific instances, especially given the low spatial extent of mining in the South Fork Eel River.

Reduced Riparian Vegetation: Trinity River

Riparian vegetation is generally not found on the Trinity River bars where extraction occurs because due to natural scouring at high flows in the confined channel. Where vegetation does occur, past extraction has avoided those areas and those practices are expected to continue. There has been no loss of riparian vegetation as a result of the last five years of operations (2009-2014), and this trend is expected to continue because the 2015-2025, proposed actions affords the same protections to riparian vegetation.

Table 2-20. Summary of adverse effects, by ESU/DPS and population.

ESU/DPS	Population	Summary of Effects: Suppressed Migration (holding)				Reduced Spawning Success				Reduced Rearing Benefits				Crushing and Burying				Elevated Stranding				Improved Migration				Accelerated Predation			
	Life Stage:*	E	Y	J	A	E	Y	J	A	E	Y	J	A	E	Y	J	A	E	Y	J	A	E	Y	J	A	E	Y	J	A
SONCC Coho Salmon	Lower Trinity										x	x							x	x							x	x	
	All others (Trinity)										x	x							x	x							x	x	
	Mattole River				x						x	x							x	x							x	x	
	Bear River				x						x	x							x	x							x	x	
	L. Eel/Van Duzen				x						x	x							x	x					x		x	x	
	Mainstem Eel				x						x	x							x	x							x	x	
	South Fork Eel				x						x	x							x	x							x	x	
	All Others (Eel)				x						x	x							x	x							x	x	
CC Chinook Salmon	Bear River				x						x	x							x	x							x	x	
	Mattole River				x						x	x							x	x							x	x	
	Lower Eel River				x	x					x	x							x	x					x		x	x	
	Upper Eel River				x	x					x	x							x	x							x	x	
NC Steelhead - Summer Run	Mattole River				x						x	x			x				x	x							x	x	
	Van Duzen				x						x	x			x				x	x					x		x	x	
	South Fork Eel				x						x	x			x				x	x							x	x	
	All others (Eel)				x						x	x			x				x	x							x	x	
NC Steelhead - Winter Run	Mattole				x						x	x			x				x	x							x	x	
	Bear River				x						x	x			x				x	x							x	x	
	Van Duzen				x						x	x			x				x	x					x		x	x	
	Lower Eel				x						x	x			x				x	x							x	x	
	L. Mainstem Eel				x						x	x			x				x	x							x	x	
	South Fork				x						x	x			x				x	x							x	x	
	All others (Eel)				x						x	x			x				x	x							x	x	

* E= Egg, Y=YOY, J= Juvenile/Smolt, and A=Adult

2.4.1.4.7 *Effects of Interrelated and Interdependent Actions*

Effects of the Proposed Action are analyzed together with the effects of other activities that are interrelated to, or interdependent with, that action. These include actions that are part of the proposed action and depend on the proposed action for their justification (interrelated actions) as well as actions that have no independent utility apart from the Proposed Action (interdependent actions, 50 CFR § 402.02). There are no known interrelated or interdependent actions.

2.5 Cumulative Effects

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

NMFS must consider both the "effects of the action" and the cumulative effects of other activities in determining whether the action is likely to jeopardize the continued existence of the three salmonid species considered in this Opinion or result in the destruction or adverse modification their designated critical habitat. Under the ESA, cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. Listed salmonid species may be affected by numerous future non-federal activities, including timber harvest, road construction, residential development, and agriculture, etc., which are also discussed in the *Environmental Baseline* section. NMFS assumes these activities, and similar resultant effects, on listed salmonids species will continue through the term of the LOP 2015 and the HVT individual permit for gravel mining (*i.e*., 11 years) and associated POI. Although each of these categories of activities may reasonably be expected to occur based on their past occurrence, definitive information on the magnitude (amount or extent), or specific location, is not known.

2.6 Integration and Synthesis

The Integration and Synthesis section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the effects of the action (Section 2.4) to the environmental baseline (Section 2.3) and the cumulative effects (Section 2.5), taking into account the status of the species and critical habitat (section 2.2), to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species.

The preceding analyses focused on both the likely direct and indirect effects from LOP 2015 and HVT gravel mining operations on listed salmonids and their habitat in the action area. This section considers the overall effects on listed salmonids, and their constituent populations, in the context of other activities occurring within the action area or influencing conditions within the action area (*Environmental Baseline* and *Cumulative Effects* sections).

In the VSP model, the assessment of viability rests on the number of spawners in each population or species, as described in the *Status of the Species* and *Environmental Baseline* sections of this Opinion. The following subsections analyze whether the proposed action is likely to jeopardize NC steelhead, CC Chinook salmon or SONCC coho salmon.

The proposed action results in the death or injury of adult and juvenile listed salmonids from multiple populations. Some of these populations occur upstream of the action area, but associated adult and juvenile members must migrate through the action area to travel to the ocean and back. HVT gravel operations only affect SONCC coho salmon in the Trinity River. Most of the action area does not support summer rearing of juvenile coho salmon or Chinook salmon because of inhospitable water temperature. Juvenile NC steelhead may use the action area for summer rearing and the Trinity River reach may support limited summer rearing of coho salmon juveniles.

2.6.1 <u>NC Steelhead Risk of Extinction</u>

The Eel River includes 26 populations that will be affected. The Bear River has a single population and the Mattole River has a winter-run and a summer-run population.

2.6.1.1 Population Size

A small number of YOY and juvenile NC steelhead will be killed or injured compared to the abundance of all the affected populations. The loss of a small number of YOY and juveniles translates into a small loss of 2+ smolts that enter the ocean, and a negligible reduction in returning spawning adults. This negligible reduction would be spread across many populations, over approximately 6 to 14 years. Therefore, NMFS does not anticipate more than a negligible decrease in spawning adults in any single population. This slight level of reduction in spawning adults is not expected to appreciably reduce the viability of the NC steelhead populations in the NC steelhead DPS, consequently, it is not expected to appreciably reduce the viability of the NC steelhead DPS.

2.6.1.2 Population Productivity

As the viability of the NC Steelhead DPS is not expected to be reduced by the death or injury of a very small number of juveniles, the productivity of the populations is not expected to be reduced by the negligible number of spawning adults affected considering the number of spawning adults remaining. In addition, the decrease in spawning adults is expected to be spread among all of the populations, so no single population is expected to be measurably affected. Therefore, the viability of the DPS is not expected to be reduced to the extent that it threatens the continued existence of the ESU.

2.6.1.3 Spatial Structure

Although multiple NC steelhead populations are affected, it is unlikely that all of the populations will be affected to the extent that adult escapement is reduced in all of the populations during every year. Therefore, the spatial structure of the steelhead populations is not expected to suffer, as the viability of the population will likely remain unchanged, access will not be affected, and no single population will be affected to the extent that adult escapement is appreciably reduced.

2.6.1.4 Diversity

The diversity of affected steelhead populations is not expected to be reduced by the loss of a negligible number of adult steelhead per year as this decrease is not expected to result in phenotypic or genotypic changes.

2.6.1.5 Summary

The viability of any of the 26 populations of steelhead will not be affected. Therefore, a decrease in the viability of the NC steelhead DPS is not expected. Overall, the numbers of spawners are not expected to be appreciably reduced to the extent that reductions in the populations' likelihood of survival and recovery would be expected to reduce the likelihood of survival and recovery of the species at the DPS level.

2.6.2 Effects on CC Chinook Salmon

Four populations of CC Chinook salmon are affected. These include two populations in the Eel River, and the Bear and Mattole River populations.

2.6.2.1 Population Size

The Van Duzen River and South Fork Eel River portions of the action area have limited numbers of Chinook salmon spawning. There will be a slight reduction in egg-to-fry success for CC Chinook salmon primarily because some redd scour and sedimentation is expected to continue. However, these impacts are expected to occur in localized settings adjacent to specific extraction areas (Van Duzen River and South Fork Eel River) and reductions in emergence rates will be limited to a few individual redds. We do not expect that the number of juvenile Chinook salmon that eventually migrate to the ocean will be appreciably reduced by the localized reduction in fry emergence.

Winter rearing habitat that includes bar areas and backwaters that will be affected by the proposed actions may be reduced in quality. This will result in a negligible decrease in juvenile survival. We anticipate stranding of adult Chinook salmon may occur in trenches due to unforeseen changes in river configuration, although this loss is not expected to occur every year if it occurs at all. We expect the trenches will increase the reproductive success of Chinook salmon by providing increased access to spawning habitat and reduced natural stranding. On balance, we expect trenches constructed under LOP 2015-1 will provide a benefit to the species. Trenches also provide additional adult holding habitat to alleviate crowding of adults in the mainstem of the Eel River. Beyond this benefit, the affected CC Chinook salmon populations are unlikely to experience either positive or negative growth since habitat will remain in a relatively similar state and the losses of juveniles will be very minor when compared to the high mortality rates these early life history phases typically experience (Groot and Margolis 1991). Therefore, we do not expect an appreciable reduction in the number of returning adults in the affected populations.

2.6.2.2 Population Productivity

As the viability of the four affected populations is not expected to be reduced by the slight reduction in egg to fry emergence success of a very limited number of redds or the death or injury of a very small number of juveniles or adults, the productivity of the population is not expected to be reduced by the negligible number of eventual spawners lost given the relatively large number of spawners remaining. Therefore, the viability of the CC Chinook salmon ESU is not expected to be reduced to the extent that it threatens the continued existence of the ESU.

2.6.2.3 Spatial Structure

The spatial structure of the affected CC Chinook salmon populations is not expected to change, as the viability of the population will likely remain unchanged and access will not be reduced.

2.6.2.4 Diversity

The diversity of the affected CC Chinook salmon populations is not expected to be reduced by the loss of a negligible number of adult Chinook salmon per year as this decrease in spawning numbers is not expected to result in phenotypic or genotypic changes.

2.6.2.5 Summary

The viability of any of the four populations of CC Chinook salmon will not be affected. Therefore, a decrease in the viability of the CC Chinook salmon ESU is not expected. Overall, the numbers of spawners are not expected to be appreciably reduced to the extent that reductions in the populations' likelihood of survival and recovery would be expected to reduce the likelihood of survival and recovery of the species at the ESU level.

2.6.3 Effects on SONCC Coho Salmon

Twelve populations of SONCC coho salmon will be affected. These include seven populations in the Eel River, three populations in the Trinity River and the Bear River and Mattole River populations.

2.6.3.1 Population Size

Coho salmon juveniles that emigrate from upstream areas and tributaries will be affected but there will be a negligible decrease in survival. Winter rearing habitat that includes bar areas and backwaters may be reduced in quality. We think that tributaries outside of the action area support most of the affected SONCC coho salmon spawning populations. Additionally, the action areas, except the Trinity River action areas provide limited rearing habitat for coho salmon because of lethal summer water temperatures and degraded habitat. Therefore, the decrease in rearing habitat is not expected to measurably influence juvenile coho salmon survival, so we do not expect that the adult coho salmon abundance in any of the populations will be reduced.

In the Trinity River, the action areas may provide limited juvenile coho salmon rearing in the summer where cold water tributaries enter the mainstem. However, the Trinity River action areas are mostly used for migration and rearing during fall, winter, and spring. A slight reduction in rearing habitat is expected in the Trinity River that may result in a slight decrease in juvenile survival. However, this slight increase in juvenile survival is not expected to appreciably reduce the number of adults that return to spawn in the Trinity River. Therefore, we do not expect any changes in viability for any of the affected SONCC coho salmon populations.

2.6.3.2 Population Productivity

As the viability of the twelve affected populations is not expected to be reduced by the slight reduction survival of juvenile coho salmon, the productivity of the populations is not expected to be reduced. Therefore, the viability of the SONCC coho salmon ESU is not expected to be reduced to the extent that it threatens the continued existence of the ESU.

2.6.3.3 Spatial Structure

The spatial structure of the twelve SONCC coho salmon populations is not expected to change, as the viability of the populations will remain unchanged and access will not be affected.

2.6.3.4 Diversity

The diversity of the twelve SONCC coho salmon populations is not expected to be reduced by the loss of a small number of juvenile coho salmon.

2.6.3.5 Summary

A decrease in the viability of the twelve populations of SONCC coho salmon is not expected because the small decrease in juvenile survival is not expected to result in a decrease in adult coho salmon in any of the twelve affected populations. Therefore, a decrease the viability of the SONCC coho salmon ESU is not expected. Overall, the numbers of spawners are not expected to be appreciably reduced to the extent that reductions in the populations’ likelihood of survival and recovery would be expected to reduce the likelihood of survival and recovery of the species at the ESU level.

2.6.4 Effects on Critical Habitat

2.6.4.1 NC Steelhead

Implementation of the proposed action will result in localized, minor reductions in the quality and quantity of juvenile rearing habitat for NC steelhead. The localized reductions in rearing habitat will be temporary as higher flows replenish gravel to the mining sites, are dispersed throughout the watershed, and are relatively minor because the mining intensity is not high. The localized impacts to rearing habitat are extremely minor, and are insignificant when compared to the available rearing habitat throughout the Eel River, Van Duzen River, South Fork Eel River, Mattole River, and Bear Creek. Therefore, there will not be a reach-wide decline in overall habitat quantity and quality, and the conservation value of that habitat will not be appreciably diminished. Therefore, we have determined that implementation of the proposed action is not likely to appreciably diminish the value of designated critical habitat for the conservation of NC steelhead.

2.6.4.2 CC Chinook Salmon

Implementation of the proposed action will result in localized, minor reductions in the quality and quantity of rearing and spawning habitat for CC Chinook salmon. The localized reductions in rearing habitat will be temporary as higher flows replenish gravel to the mining sites, are dispersed throughout the watershed, and are relatively minor because the mining intensity is not high. Spawning habitat in the vicinity of the extraction sites in the South Fork Eel River and the Van Duzen River may be less suitable, but these sites are not key spawning areas for Chinook salmon. Chinook salmon utilize the extraction area in the South Fork Eel River and the Van Duzen River primarily when upstream access has been hindered. The localized impacts to rearing and spawning habitat are extremely minor, and are insignificant when compared to the available rearing and spawning habitats throughout the Eel River, Van Duzen River, South Fork Eel River, Mattole River, and Bear Creek. Therefore, there will not be a reach-wide decline in overall habitat quantity and quality, and the conservation value of those habitats will not be appreciably diminished. Adult holding and migration habitat are expected to be enhanced for Chinook salmon from deeper channels created by trenching, especially with the addition of woody debris. Therefore, we have determined that implementation of the proposed action is not likely to appreciably diminish the value of designated critical habitat for the conservation of CC Chinook salmon.

2.6.4.3 SONCC Coho Salmon

Implementation of the proposed action will result in localized, minor reductions in the quality and quantity of juvenile rearing habitat for SONCC coho salmon. The localized reductions in rearing habitat will be temporary as higher flows replenish gravel to the mining sites, are dispersed throughout the watershed, and are relatively minor because the mining intensity is not high. The localized impacts to rearing habitat are extremely minor, and are insignificant when compared to the available rearing habitat throughout the Eel River, Van Duzen River, South Fork Eel River, Trinity River, Mattole River, and Bear Creek. Therefore, there will not be a reach-wide decline in overall habitat quantity and quality, and the conservation value of that habitat will not be appreciably diminished. Adult holding and migration habitat are expected to be enhanced for coho salmon from deeper channels created by trenching. Therefore, we have determined that implementation of the proposed action is not likely to appreciably diminish the value of designated critical habitat for the conservation of SONCC coho salmon. SONCC coho salmon critical habitat does not occur on the HVIR, therefore, the HVT proposed action will not affect critical habitat.

2.7 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' biological opinion that the the Humboldt LOP 2015 and HVT individual permit for gravel mining, as proposed, is not likely to jeopardize the continued existence of NC steelhead, CC Chinook salmon, or SONCC coho salmon; and is not likely to result in the destruction or adverse modification of NC steelhead, CC Chinook salmon, or SONCC coho salmon critical habitat.

2.8 Incidental Take Statement

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

The measures described below are non-discretionary and must be undertaken by the Corps so that they become binding conditions of any grant or permit issued to an applicant, as appropriate, for the exemption in section 7(o)(2) to apply. If the Corps fails to assume and implement the measures or fails to require the applicant to adhere to the measures through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impact on the species to NMFS as specified in the ITS [50 CFR § 402.14(i)(3)].

2.8.1 Amount or Extent of Take

In the biological opinion, NMFS determined that incidental take would occur as follows:

NMFS anticipates that annual gravel mining operations under the LOP 2015-1 will result in take of SONCC coho salmon, CC Chinook salmon and NC steelhead within the action area. NMFS expects temporary physical habitat impacts will occur primarily within the extraction areas. The temporary physical habitat impacts will primarily influence the availability of shelter during high flows which inundate extraction areas as well as reduce the quality and quantity of juvenile rearing habitat (i.e., reductions in coarse substrate, deep water habitats, riparian vegetation and velocity refugia) for SONCC coho salmon, CC Chinook, and summer and winter run NC steelhead. The impairment of essential behavior patterns of juveniles resulting from the temporary loss of habitat, short-term increases in turbidity, and displacement during instream bridge construction is likely. We also expect that localized changes in habitat will result in a small reduction in the emergence of fry from redds within the Van Duzen and South Fork Eel rivers, adjacent to and immediately downstream of the extraction sites. Reductions in habitat and alterations in essential behavioral patterns will result in both decreased growth rates and ocean survival. Overall, we anticipate that the number of individuals harmed resulting from these annual temporary habitat changes will be low.

NMFS is unable to estimate the number of individuals that will experience lower survival as a result of the proposed action. The number of coho salmon, CC Chinook, and NC steelhead occupying the action area is dependent on their population size and hydrology which varies spatially and temporally throughout the extraction reaches. We anticipate that a small number of steelhead juveniles may be crushed during construction and removal of temporary channel crossings (bridges). In addition, we expect that adults and juveniles of all three species may become stranded in trenches and wetland pits. Although the trenches and wetland pits will be designed to avoid stranding, unexpected river changes may cause stranding of fish with mortality before fish rescue operations commence. While we cannot reliably estimate the number of individuals that may become stranded in a given year, NFMS expects that the probability of stranding is very low due to minimization measures included in the LOP 2015-1, but if stranding occurs, then a small number of juveniles or adults (in any combination of the three species) may become stranded and die in trenches or wetland pits. Overall, the effects of the action vary based on the extraction intensity, location, and hydrological factors. NMFS is using two surrogates for the amount of take which could occur. The surrogates are based on the maximum extraction acreage and the maximum extraction volumes of each extraction reach during the 2005 through 2014 permit periods. NMFS does not expect the maximum acreage for LOP 2015-1 to increase due to site specific volume limitations. The maximum extraction acreage and maximum volume for each reach from 2005 through 2014 is as follows:

- Lower Eel River: 42.3 acres/215,760 cu. yds.

- Middle Eel River: 9.3 acres/64,424 cu. yds.

- South Fork Eel: 9.5 acres/73,956 cu. yds.

- Van Duzen River: 29.3 acres/137,850 cu. yds.

- Mattole River/Bear River/PL Bar/Fort Seward: 2.6 acres/14,064 cu. yds.

NMFS expects that physical habitat impacts will be: (1) limited to the habitat adjacent to and immediately upstream of and downstream of the extraction areas described in Table 2-21 below; (2) compliant with the minimization measures of the LOP 2015-1; and (3) within the expected effects of the proposed action as described in this Opinion. Critical minimization measures in the LOP 2015-1 include, implementing a head-of-bar buffer, giving preference to alternative extraction techniques on the South Fork Eel River, Lower Eel River and Van Duzen River, and limiting the type of skimming on the Van Duzen River to narrow skims with widths of no more than 90 feet as measured across the top of the extraction. We expect more frequent use of alcoves, trenches and narrow skims in these reaches in lieu of traditional skimming, and that a fish migration channel will be designed and implemented in the Van Duzen River delta at the

Leland Rock site and the Hauck Bar site. We also expect that trenching will be used at the Bess and Noble sites.

The duration of effects is anticipated to extend from 2015-2025, and possibly beyond. Although many of the effects will be short-lived and occur on a seasonal basis (*e.g.*, effects of bridge construction), effects to habitat and consequent incidental take of coho salmon, Chinook salmon and steelhead juveniles may persist beyond a given extraction season.

2.8.2 Hoopa Valley Tribe

NMFS anticipates that HVT gravel mining operations as permitted under the CWA section 404 permit will result in incidental take of naturally produced, unmarked coho salmon in the Trinity River. NMFS expects that temporary physical habitat impacts will occur primarily on the extraction areas. These changes will primarily influence the sheltering of coho salmon juveniles during higher flows that inundate the extraction areas. These localized changes in habitat will reduce juvenile rearing habitat. We expect impairment of essential behavior patterns of juveniles as a result of a temporary loss of habitat (*i.e*., coarse substrate), short-term increases in turbidity and fine sediment, and from being displaced during instream heavy equipment activity from bridge construction. These reductions in habitat and behavioral displacement of juveniles will increase competitive pressures on the affected individuals resulting in decreased growth rates and lower ocean survival. Coho salmon that are displaced from rearing areas will be subject to increased predation. We expect that very few juvenile coho salmon will be harmed as a result of these changes in habitat per year and no adults will be affected.

NMFS is unable to determine the number of individuals that will experience lower survival as a result of the HVT's proposed action because the number of coho salmon that occupy the action area varies temporally and spatially in response to population size, hydrology, and other factors that will influence their use of the action area. In addition, the effects of the action will vary based on extraction intensity, location, and the persistence of changes in the bar caused by extraction that will vary due to hydrologic and other factors. Therefore, NMFS is using a surrogate for the amount of take in terms of the extent of the gravel bars that may be mined in the action area. The distance of river where the bars occur is approximately 5.3 river miles. In addition, the acreage of the bars is:

- Tish Tang Campround Bar = approx. 9.7 acres

- Tish Tang Creek Bar = approx. 1.2 acres

- Campbell Bar = approx. 3.2 acres

- Tish Tang #8 Bar = approx. 15.2 acres

- Cal Pac Bar = approx. 5.4 acres

- Security East Bar = approx. 11.4 acres

The duration of effects is anticipated to extend from 2015-2025, and possibly beyond. Although many of the effects will be short-lived and occur on a seasonal basis (*e.g.*, effects of bridge construction), effects to habitat and consequent incidental take of coho salmon may persist beyond a given extraction season. Anticipated incidental take may be exceeded if gravel extraction operations extend beyond the described action area in either volume (100,000 cubic yards) or spatial extent (as described above), are not in compliance with the applicable minimization measures, or if effects of gravel extraction operations are exceeded or different than the effects described in this Opinion.

Table 2-21. For each river, gravel bar sites are listed from the most upstream site to the most downstream site, and are not necessarily contiguous. The approximate length of each site is measured along the center-line of the stream, adjacent to each bar. Data was provided by Humboldt County Planning Division (April 26, 2000), except for the Cook's Valley site and the Fort Seward site where data was provided by the Corps (June 27, 2000), and the McKnight site, where data was provided by the Corps (June 25, 2001), and the HVT sites where data was provided by NMFS (2009).

Stream	Length (ft)	Gravel Bar Site Name
Middle Eel River	3646	Vroman and Maynard Bars
	4160	Truck Shop and Scotia Bars
	8340	Dinner Creek and Three Mile Bars
	8398	Elinor Bar
	4844	Holmes Bar
	7900	Dyerville, South Fork and Bowlby Bars
Lower Eel River	1117	Hansen Bar
	1754	Upper Sandy Prairie Bar
	3507	Canevari - Sandy Prairie Bar
	2160	Lower Sandy Prairie Bar
	3413	Warswick Bar
	2807	Singley Bar (downstream of Fernbridge)
South Fork Eel River	809	Cook's Valley (at the Humboldt/Mendocino County line)
	1218	Tooby Park/Garberville
	2097	Randall Sand and Gravel/Tooby Park/Garberville
	1854	Wallen/Johnson Redway Bar (near the town of Redway)
Van Duzen River	2304	Pacific Lumber Bar (near the town of Carlotta)
	661	Thomas Bess Ranch
	15506	Van Duzen River Ranch
	1890	Leland Rock Gravel Bars

Stream	Length (ft)	Gravel Bar Site Name
Lower Trinity River	2000	McKnight Bar (near the town of Salyer)
	4497	Big Rock (near the town of Willow Creek)
	834	Klamath River Aggregate (near the town of Hoopa)
North Fork Mattole	4909	Cook Bar (at confluence with mainstem Mattole River)
Upper-Mid Eel	2000	Satterlee Bar near Fort Seward, at approximate river mile 68
Bear River	975	Branstetter Bar

2.8.3 Effect of the Take

In the biological Opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to SONCC Coho salmon, CC Chinook salmon, or NC steelhead or the destruction or adverse modification of critical habitat when the reasonable and prudent alternative is implemented.

2.8.4 Reasonable and Prudent Measures

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

2.8.4.1 LOP 2015-1

NMFS believes that the following reasonable and prudent measures are necessary and appropriate to minimize take of SONCC coho salmon, CC Chinook salmon and NC steelhead resulting from implementation of the proposed action.

The Corps shall:

1. Ensure that the monitoring necessary to track changes to salmonid habitat quality and quantity in the vicinity of gravel extraction sites is implemented.
2. Ensure that wetland pits are located above the 2-year flood frequency elevation.
3. Recommend that the County updates the 1994 Eel River Final PEIR to reflect changes in the status of the species, environmental baseline, and gravel extraction practices.

2.8.4.2 Hoopa Valley Tribe

NMFS believes that the following reasonable and prudent measure is necessary and appropriate to minimize take of SONCC coho salmon resulting from implementation of the proposed action.

The Corps shall:

1. Ensure that the monitoring necessary to track changes to coho salmon habitat quality and quantity in the vicinity of gravel extraction sites is implemented.

2.8.5 <u>Terms and Conditions</u>

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

2.8.5.1 LOP 2015

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

Ensure that the monitoring necessary to track changes to salmonid habitat quality and quantity in the vicinity of gravel extraction sites is implemented.

a. The Corps will ensure that all required monitoring is completed annually. This requirement includes both the biological monitoring that is described in the biological monitoring plan dated February 2015 and added to the LOP 2015-1 on April 4, 2015, as Appendix D, and the physical monitoring that is described in Appendix C of the LOP 2015-1. Completion of required monitoring will be documented by development of a tracking system by the Corps that clearly shows that all applicants meet all monitoring requirements annually. The tracking system will be developed and implemented by the Corps by December 31, 2015.

b. The Corps will provide a cross section data protocol and reporting format that NMFS and CHERT have reviewed to ensure that all data is provided in a consistent format. If modifications to the protocol are necessary, proposals for the modifications will be circulated to CHERT, NMFS and the applicants for review and comment prior to approval and implementation.

c. Ensure that the site-specific checklists required by the LOP 2015-1 (Appendix N of the LOP 2015-1 provides an example checklist) are completed annually for all mining sites.

d. Ensure that monitoring reports are provided to NMFS each year by December 31. Reports shall be submitted to:

Matt Goldsworthy
Acting North Coast Branch Chief
National Marine Fisheries Service
1655 Heindon Road
Arcata, California 95521

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

Ensure that wetland pits are located above the 2-year flood elevation in order to reduce the potential for salmonid stranding.

a. Pre-extraction plans will provide either an air photo showing observed edge of water of the previous winter flood flow with a frequency above the 2-year flood and below the proposed wetland pit location or a HEC-RAS model will be provided that demonstrates that the location of wetland pits are above the 2-year flood level.

2.8.5.2 Hoopa Valley Tribe

The Corps, and its applicant, the HVT, must comply with the following terms and conditions, which implement the reasonable and prudent measures described above. These terms and conditions are non-discretionary.

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

Ensure that the proposed monitoring to track changes to Coho salmon habitat quality and quantity in the vicinity of gravel extraction sites is implemented.

a. The Corps will ensure that all required monitoring is completed annually. Completion of required monitoring will be documented by development of a tracking system by the Corps that clearly shows that the HVT meets all monitoring requirements annually. The tracking system will be developed and implemented by the Corps by December 31, 2015.

b. Ensure that all monitoring reports are provided to NMFS each year prior to December 31. Reports shall be submitted to:

Matt Goldsworthy
Acting North Coast Branch Chief
National Marine Fisheries Service
1655 Heindon Road
Arcata, California 95521

2.9 Reinitiation of Consultation

2.9.1 LOP 2015

This concludes formal consultation for LOP 2015. As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) the amount or extent of incidental taking specified in the incidental take statement is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action.

For example, reinitiation of consultation may be required if (1) the extraction intensity that was analyzed in the Opinion by river reach is exceeded, and if greater mining intensity results in habitat changes not anticipated in this Opinion; or (2) critical minimization measures such as, implementing a head-of-bar buffer, giving preference to alternative extraction techniques on the South Fork Eel, Lower Eel and Van Duzen rivers, and limiting skim widths in the Van Duzen River to no more than 90 feet as measured across the top of the extraction, are not implemented. Reinitiation of consultation is also required if additional sites other than those listed in the ITS Table 1 are authorized by the LOP 2015-1.

2.9.2 Hoopa Valley Tribe

This concludes formal consultation for the Hoopa Valley Tribe. As 50 CFR 402.16 states, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained or is authorized by law and if: (1) the amount or extent of incidental taking specified in the incidental take statement is exceeded, (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion, (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in this opinion, or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount of incidental take is exceeded, consultation shall be reinitiated immediately. For example, reinitiation of consultation may be required if minimization measures such as the head-of-bar buffer and the pre-extraction planning process are not implemented.

3 Magnusun-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation

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

This analysis is based, in part, on the EFH assessment provided by the Corps and descriptions of EFH for Pacific coast salmon (PFMC 1999) contained in the fishery management plans developed by the Pacific Fishery Management Council and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

Pacific Coast Salmon EFH will be affected by the Proposed Action. The aspects of the EFH that may be affected by the Proposed Action include adult spawning and migration habitat and juvenile rearing habitat within the Lower Eel River, Middle Eel River, South Fork Eel River, Van Duzen River, Mattole River, Bear River, and Trinity River.

3.2 Adverse Effects on Essential Fish Habitat

Effects of the proposed action on coho salmon and Chinook salmon EFH are those associated with habitat degradation from increased sedimentation and channel instability. These effects are described in the NMFS biological opinion.

3.3 Essential Fish Habitat Conservation Recommendations

NOAA Fisheries has no conservation measures to recommend over what is currently proposed. Conservation recommendations provided in past gravel mining consultations were incorporated into the proposed action.

3.4 Supplemental Consultation

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

4 Data Quality Act Documentation and Pre-Dissemination Review

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

4.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended user of this opinion is the Corps. Other interested users could include permit applicants, citizens of affected areas, and others interested in the conservation of the affected ESUs/DPS. Individual copies of this opinion were provided to the Corps. This opinion will be posted on the Public Consultation Tracking System web site (https://pcts.nmfs.noaa.gov/pcts-web/homepage.pcts). The format and naming adheres to conventional standards for style.

4.2 Integrity

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

4.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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6 ENCLOSURE 1: Appendix C: Monitoring and Submittal Preparation Guidelines

Ground surveys and aerial photography provide the primary basis for physical monitoring of extraction areas. They are also essential for project planning, proposal preparation, field reviews, project modification, and compliance verification. Although technological advancements in recent years have lowered the costs and increased the accuracy of digital terrain modeling (DTM), the more conventional cross section surveys are still in common use by Humboldt County's mining industry. Consequently, the guidelines below focus on conventional cross section surveys. However, use of DTM-based monitoring information is encouraged and should provide much of the same information (*e.g*., elevations of the water surface, top of silt band, etc.) discussed below.

The physical monitoring program relies on two types of cross sectional measurements: Monitoring Cross Sections and Extraction Zone Cross Sections. *Monitoring cross-sections* are permanent, monumented cross sections whose purpose is to document yearly and long-term changes in river channel elevation and morphology at extraction sites and adjacent reaches. They also aid in extraction planning, field reviews, and, in some cases, estimation of volumes extracted. *Extraction zone cross-sections* (both pre- and post-extraction) are temporary, seasonal cross-sections used for the planning of an extraction, for estimation of the actual volume extracted, and for evaluating compliance with approved gravel extraction plans.

E1: Monitoring Cross-Sections

Monitoring cross-sections shall be measured the year-of, and once during the year following any mining activity. For example, if extraction is planned to take place in 2015, then monitoring cross-sections are required for 2015 and 2016. Monitoring cross sections are required at least once every 5-years for all bars, whether they are mined or not. Most monitoring cross-sections have already been established in previous years. Requirements for establishment of monitoring cross-sections are discussed in the *Establishing Monitoring Cross Sections* section below.

Requirements for Monitoring Cross-Sections

1. All survey data must be referenced to State Plane (FIPS 0401) coordinate system, and the 1983 North American Datum (NAD) and 1988 North American Vertical Datum (NAVD88). Cross-sections must be resurveyed from the same endpoints each year. The endpoints should be located at or above the 100-year flood water surface elevation unless another flood level is agreed upon by agencies and CHERT and far enough from the river's edge to remain consistent from year to year.
2. Previous years topography that clearly has not changed over the year may be used in the upper elevations of the cross section but the current year's survey must include those portions of each cross-section inundated or affected by the previous winter's highest flow. Plots must include accurate representations of all ground topography between endpoints and clearly label where older (previous survey) data are used. This is included as a cost saving measure for areas where it is clear that no scour or deposition has occurred since the previous survey.

3. If flow conditions make below-water portions of the cross section unsafe to survey prior to the site visit, those sections may be completed as soon as flow conditions allow and must be included in the final monitoring submittal for the year.
4. Maximum distance between any two elevation points along a cross-section shall be 50 feet, including the wetted channel portion. Exception: if ground outside wetted channel is essentially smooth and rises less than 0.5 feet for a distance of 100-feet, distance between points can be increased to 100 feet. All obvious breaks in slope must still be included in order to collect accurate topography that is representative of site conditions.
5. All gravel bars must have monitoring cross sections re-surveyed at a minimum of every 5-years.
6. During years in which gravel extraction is planned, stake or spray paint (using non-toxic paint) the following points on the ground in each cross-section at time of survey:
   a. Water's edge on at least one side of the river; or both sides of the river if it is feasible. If this is not practicable, stake at 10 feet offset from water's edge. Position the stake to be included in the survey.
   b. The water surface near the 35% exceedence level along the main channel and along overflow channels containing the 35% flow. The actual 35% flow elevation should be calculated using the data sheets provided at the time of extraction design.
   c. Top of the silt band if visible.
7. Where discernible, the elevation and position of high-water marks for previous winter's flow (floodmarks, debris lines, swept or racked vegetation, etc) should be identified on the cross-sections.
8. Water discharge at time of survey (from nearest USGS gage) to be shown in legend.
9. Re-survey all monitoring cross-sections which overlap an extraction area immediately following extraction, before flows or rain affect the zone. Only resurvey through those portions of the cross-section altered by extraction, temporary stockpiles, road construction, or other types of ground disturbance. See Figure 1.
10. Cross-section plots and worksheets should denote the position and elevation (to the nearest 0.1 foot) of the following points:
    a. End points.
    b. The top of the silt band adjacent to the low flow channel, if visible.
    c. The corrected 35% flow exceedence water surface elevation (during years planned for extraction).
    d. **E**xisting Water surface elevation at time of survey.
    e. Edge of woody or riparian vegetation stands.
    f. Any other features useful for field orientation and review.

11. Cross-sections at all sites shall be plotted at the same vertical and horizontal scales (Horizontal 1-inch = 100-feet; Vertical 1-inch = 10-feet).
12. Cross-section plots shall be cut and stacked so that whole cross-sections can be placed on one page and be consistently presented each year.
13. Cross-sections shall be surveyed and drafted consistently so that the right bank (RB) of the river as you face downstream is at the right side of the drafted cross-section. Zero (0) distance in cross-sections shall be at the left (LB) endpoint as you face downstream.
14. Cross sections shall be plotted on gridded paper, where the grid logically corresponds to the scale at which the cross-section is plotted. We suggest a grid of 10 squares to the inch. Grid shall be visible in the reproduced paper copies provided to the agencies.
15. Cross sections shall have clearly labeled vertical and horizontal axes. Each cross section should have its own horizontal axis to facilitate measurement of distances (rather than a single set of axis labels at bottom of page). Each cross-section should have its origin on a heavy grid line.
16. Any endpoints lost due to changes to the bank shall be clearly noted along with the length and direction of change(s) on the cross section plots.

Establishing Monitoring Cross-Sections

1. Cross Section endpoints and benchmarks shall be established in accordance with the following specifications:
   a. The endpoints should be located at or above the 100-year flood water surface elevation unless another flood level is agreed upon by agencies and CHERT.
   b. Clearly monumented and labeled in the field and accurately located on current air photos and maps. A common color of flagging, or environmentally benign painting shall be used to mark cross-sections at all sites.
2. Cross-sections shall be oriented perpendicular to a hypothetical center line for the ‘frequently scoured’ river channel, and delineating the zone of frequent bedload movement (annual scour and deposition This zone is typically devoid of large trees and excludes floodplains and terraces.
3. If the radius of curvature is less than ten times larger than the average frequently scoured channel width of the project reach, the reach is considered a bend. If the radius of curvature is more than ten times larger than the average actively scoured channel width of the project reach, the reach is considered straight.
4. Cross-sections shall be no more than 400 feet apart on bends and 500 feet apart in straight reaches. If the length of the project reach is not evenly divisible by 400 or 500 feet, the number of cross-sections should be rounded to the next larger number. Longer distances between cross sections or abandonment and replacement of cross sections may be allowed on a case-by-case basis.
5. The first cross-section shall extend across the channel at the upstream limit of the

project reach (entire project site); the last cross-section shall extend across the channel at the downstream limit of the project reach.

E2: Extraction Zone Cross-Sections

The extraction zone is the total area that will be extracted and/or graded as a result of gravel extraction activities. Extraction zone cross-sections (pre- and post-extraction) are required the year of any proposed mining activity.

Number and Layout of Extraction Zone Cross-Sections

1. Extraction zone cross-sections shall be surveyed prior to extraction and resurveyed once extraction is complete using State Plane (FIPS 0401) coordinate system, and the 1983 North American Datum (NAD) and 1988 North American Vertical Datum (NAVD88).
2. A minimum of 5 equally-spaced extraction cross-sections shall be surveyed in each extraction zone or area along with endpoints and end sections to enable a georeferenced extraction perimeter to be shown on the plan view photo submitted pre-extraction, and the actual extraction perimeter submitted annually in spreadsheet form.
3. Cross-sections shall be oriented perpendicular to the long-axis of the extraction area.
4. Extraction zone cross-sections should be marked with temporary (seasonal) monuments at each end, such as stakes or rebar, which can be removed after extraction is complete.

Extraction Zone Cross-Sections (Before Mining – Pre-Extraction)

1. Pre-extraction zone cross-sections in the specified coordinate system are required before agency approval of the mining plan or Letter of Modification from the Corps.
2. Pre-extraction cross-section plots shall include the pre-mining cross-section data overlain onto the proposed mining configuration.
3. The proposed area of extraction should be lightly shaded or hatched. Should changes be required for project approval, pre-extraction cross sections shall be re-submitted with the approved mining configuration.
4. If the cross-section becomes inundated by late-spring high flows after the pre-extraction survey is completed, the inundated cross-section points must be resurveyed.
5. Survey at least several weeks prior to the desired beginning date of operations to allow sufficient time for the review and approval process.

Extraction Zone Cross-Sections (After Mining – Post-Extraction)

1. Post-extraction cross-sections are to be surveyed using the specified coordinate system immediately following mining, before flows or rain affect the zone. Operators relying on extensions need to ensure that the monitoring is completed prior to river rise.
2. Post-extraction zone cross-section plots shall include the post-mining cross-section data [solid line] overlain on the approved mining configuration [dashed line]. The actual area of extraction should be lightly shaded or hatched.
3. Total volume extracted should be computed, using double end area or computer generated digital terrain models. All measurements and calculations should be included in tabular form and verified by a California Licensed Land Surveyor or appropriately authorized engineer.
4. The perimeter of each extraction zone shall be geo-referenced and accurately depicted on the post-extraction aerial photo plan views and submitted digitally in spreadsheet form.
5. All information in this section shall be included in the Annual Data Submittal.

E3: Site Visit Requirements

1. On the day of the site visit, a hard copy of the current year's monitoring cross sections is required (including the calculated 35% flow elevation). Portions of monitoring cross sections which were too deep to be surveyed may be skipped and be surveyed at a later date that same season.
2. On the day of the site visit, current year's aerial photos of the site are required unless flows remain higher than the 35% exceedence flow throughout June, in which case photos from the previous year may be used for preliminary planning.
3. The current year's monitoring cross-section overlain on the previous years (if any) monitoring cross-section. The area of the previous year's actual extraction (if any) should be lightly shaded or hatched (Figure 1).

E4: (Pre) Extraction Plan Submittal Requirements

1. All pre-extraction site maps submitted for approval are to be prepared on a color, georeferenced (or ortho-rectified) aerial photo of good quality from current year. Site maps should show the entire project area, the proposed extraction area, and other pertinent features at a scale of approximately 1:6000 (1 in = 500 ft). This may require reduction or enlargement of original air photos. See Figure 2.
2. Calculated 35% flow exceedence marked on monitoring cross section plots. Electronic plots should depict the 35% line in red.
3. When submitting a final extraction plan to the agencies for their approval, ensure that there is a brief narrative detailing the mining being proposed, including: vegetation to

be disturbed; location and description of temporary crossings and the desired flow each temporary crossing will be designed to pass; habitat improvement activities; justification and rationale for any deviation; and locations of stockpiles and haul roads.

E5: Annual Data Submittal Requirements (Post-Extraction)

1. Cross-sections, maps, and associated calculations (such as extraction volumes and surface areas) must be prepared by or under the direction of a State of California Licensed Land Surveyor or an authorized Professional Engineer and certified as to content and accuracy.

2. All plan view monitoring and extraction cross sections will be shown on the georeferenced spring aerial photos. If a site is adjacent to another actively mined site, the two sites must be georeferenced and join seamlessly within the channel and floodplain. This may require coordination between applicants (or their consultants) with adjacent sites to ensure that the georeferenced photos line up correctly. See the guidance on aerial photos in the *Requirements for Aerial Photos* section. If photos are received that are not georeferenced accurately enough to line up adjacent sites, corrections will be required.

3. All monitoring cross sections will be accurately located and labeled on the plan view site map placed over the georeferenced spring aerial photo along with cross section view in the specified scale and coordinate system. These plan view maps will be available for the pre-extraction site visit.

4. The horizontal limits (perimeter) of the actual extraction areas shall be georeferenced and included with the post-extraction submittal in electronic form, along with cross section as described above. Only the current year air photos shall be used for post-extraction submittals.

5. By December 15 of each year, all hard copies of post-extraction plots, volume calculations, aerial photos, brief narratives, and all other requirements (except for the electronic formats from Item 2 above) shall be provided to the CHERT, NMFS, CDFW, and the Corps. The brief narrative should be 1-2 pages and contain the following: (1) dates of any pre-extraction surveys and results (snowy plover, etc); (2) the beginning and end dates of gravel extraction; (3) the dates of bridge installation and removal; (4) detail on how the gravel extraction deviated in any way from the pre-extraction plan, including volumetric differences; (5) reasoning or explanation of sites that were over or under extracted; and (6) details of any biological enhancement activities.

6. By January 15 of each year, the previous years' electronic files with the Monitoring Cross-Sections shall be provided to the CHERT, NMFS, CDFW, and the Corps in the standardized reporting MS Excel spreadsheet. The data (PNEZD and Date of Capture) should be grouped by cross-section and organized from L bank to R bank. Header information shall be included with each cross section file that indicates the date of survey, cross section number, mining site, and river. The 35% water

surface elevation calculations will be included on the excel sheets with each cross section data. Other relevant information (*e.g.*, lost/re-established endpoints, etc.) shall also be included. Files shall be submitted in CD-ROM or other common media. A 'Read Me' text file may also be included if explanation of other issues is necessary (See Figure 3, Figure 4 and Figure 5).

E6: Requirements for Aerial Photos

1. Photos should be taken when flows are below 35% exceedence.
2. Photos should extend one-half a meander upstream and downstream from each mined site.
3. Only the current year photo shall be used for the post extraction submittal.
4. Airphotos shall be georeferenced to the *State Plane (FIPS 0401) coordinate system, and the 1983 North American Datum (NAD).*
5. All adjacent sites must be georeferenced in such a way that the two sites line up correctly. Misaligned airphotos will be returned to the applicants for corrections.

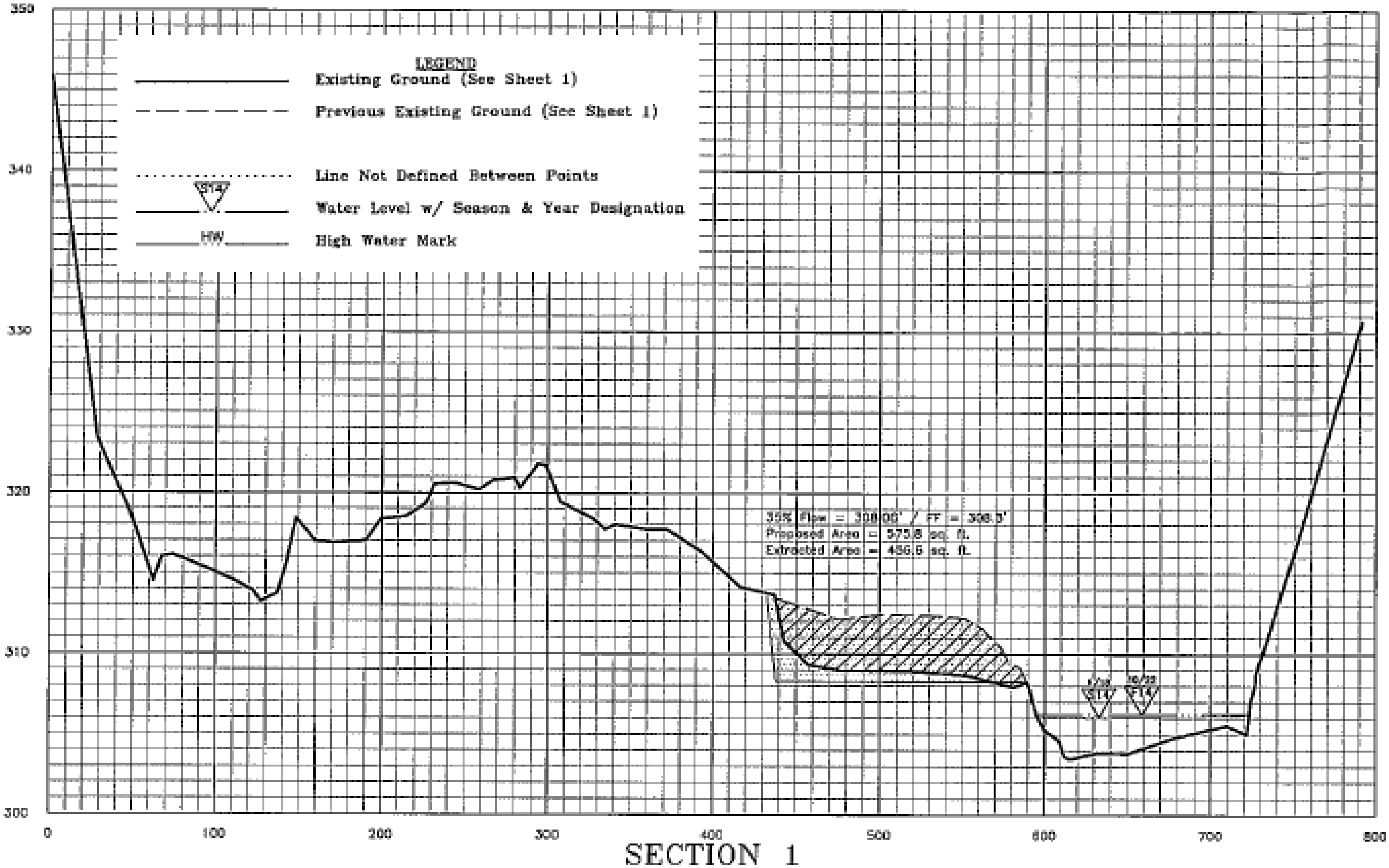


FIGURE E1: Example *monitoring cross-section* with an extraction area resurveyed post-extraction and WSE s marked (showing approved vs actual extraction).

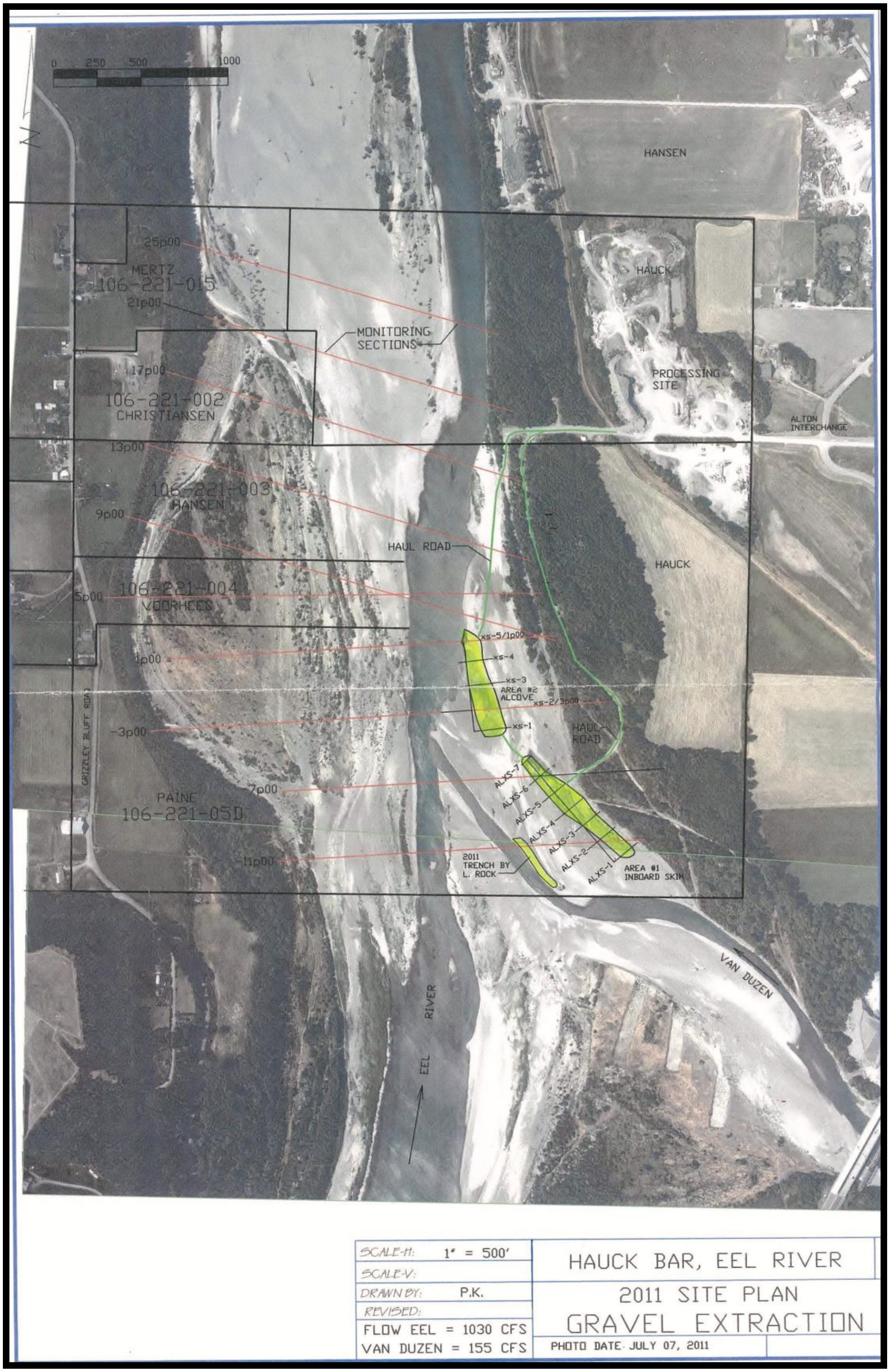


FIGURE E2: Example pre-extraction aerial photo w/ extraction zone cross sections delineated.

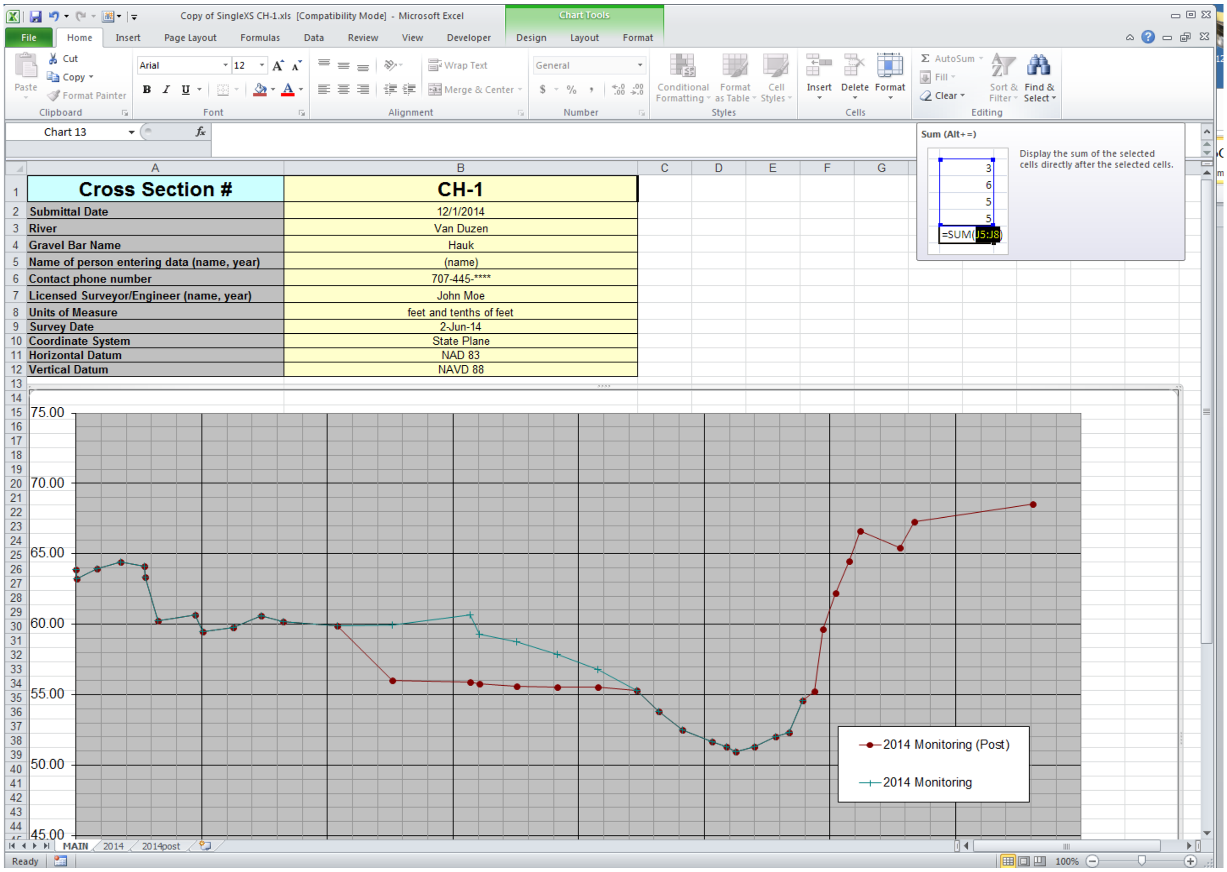


Figure E3 Front Page of each cross section Excel workbook: general cross section information with automatic plotted cross sections.

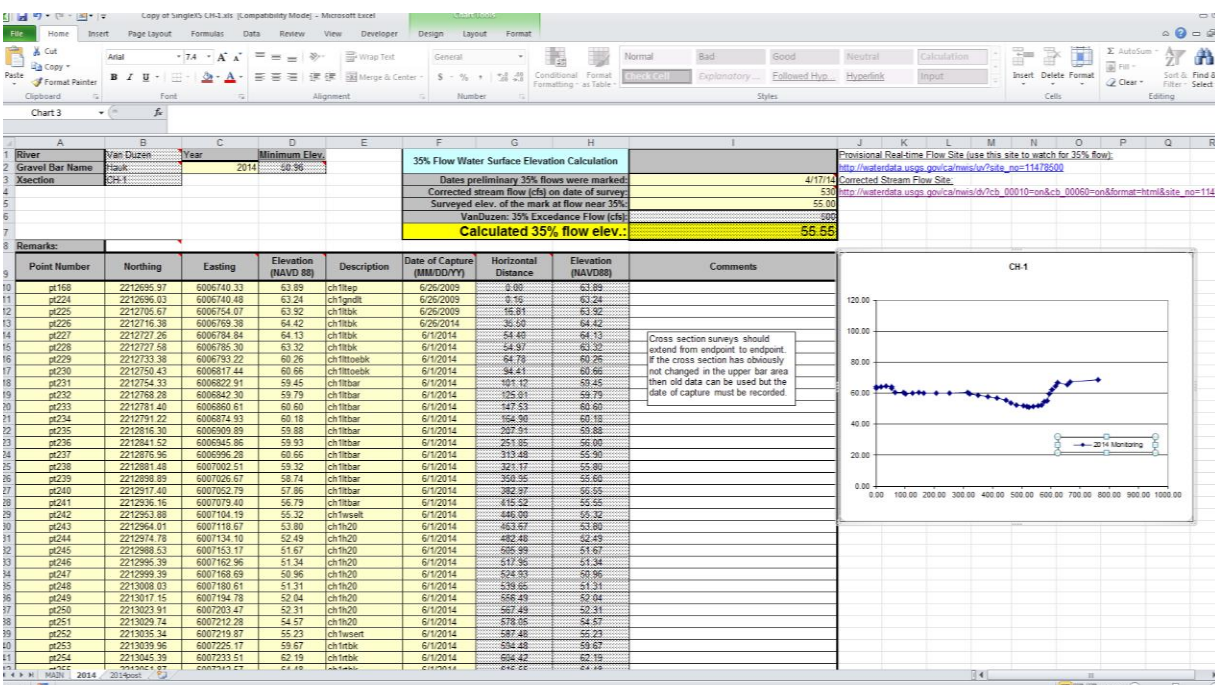
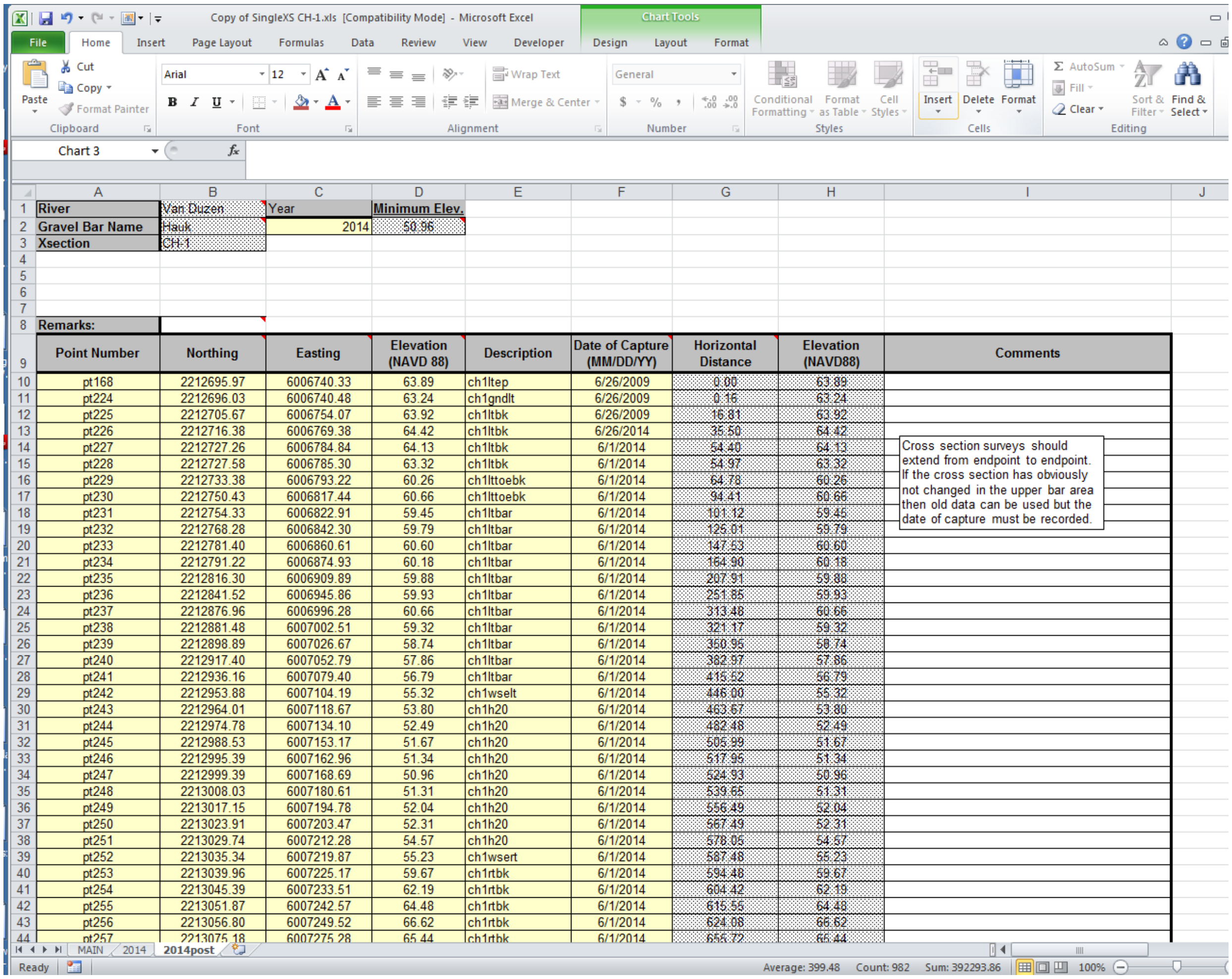


Figure E4 Second page of workbook: Monitoring Cross Section data include 35%.



	A	B	C	D	E	F	G	H	I
1	River	Van Duzen	Year	Minimum Elev.					
2	Gravel Bar Name	Hauk	2014	50.96					
3	Xsection	CH-1							
4									
5									
6									
7									
8	Remarks:								
9	Point Number	Northing	Easting	Elevation (NAVD 88)	Description	Date of Capture (MM/DD/YY)	Horizontal Distance	Elevation (NAVD88)	Comments
10	pt168	2212695.97	6006740.33	63.89	ch1ltep	6/26/2009	0.00	63.89	
11	pt224	2212696.03	6006740.48	63.24	ch1gndlt	6/26/2009	0.16	63.24	
12	pt225	2212705.67	6006754.07	63.92	ch1ltbk	6/26/2009	16.81	63.92	
13	pt226	2212716.38	6006769.38	64.42	ch1ltbk	6/26/2014	35.50	64.42	
14	pt227	2212727.26	6006784.84	64.13	ch1ltbk	6/1/2014	54.40	64.13	
15	pt228	2212727.58	6006785.30	63.32	ch1ltbk	6/1/2014	54.97	63.32	
16	pt229	2212733.38	6006793.22	60.26	ch1lttoebk	6/1/2014	64.78	60.26	
17	pt230	2212750.43	6006817.44	60.66	ch1lttoebk	6/1/2014	94.41	60.66	
18	pt231	2212754.33	6006822.91	59.45	ch1ltbar	6/1/2014	101.12	59.45	
19	pt232	2212768.28	6006842.30	59.79	ch1ltbar	6/1/2014	125.01	59.79	
20	pt233	2212781.40	6006860.61	60.60	ch1ltbar	6/1/2014	147.53	60.60	
21	pt234	2212791.22	6006874.93	60.18	ch1ltbar	6/1/2014	164.90	60.18	
22	pt235	2212816.30	6006909.89	59.88	ch1ltbar	6/1/2014	207.91	59.88	
23	pt236	2212841.52	6006945.86	59.93	ch1ltbar	6/1/2014	251.85	59.93	
24	pt237	2212876.96	6006996.28	60.66	ch1ltbar	6/1/2014	313.48	60.66	
25	pt238	2212881.48	6007002.51	59.32	ch1ltbar	6/1/2014	321.17	59.32	
26	pt239	2212898.89	6007026.67	58.74	ch1ltbar	6/1/2014	350.95	58.74	
27	pt240	2212917.40	6007052.79	57.86	ch1ltbar	6/1/2014	382.97	57.86	
28	pt241	2212936.16	6007079.40	56.79	ch1ltbar	6/1/2014	415.52	56.79	
29	pt242	2212953.88	6007104.19	55.32	ch1wselt	6/1/2014	446.00	55.32	
30	pt243	2212964.01	6007118.67	53.80	ch1h20	6/1/2014	463.67	53.80	
31	pt244	2212974.78	6007134.10	52.49	ch1h20	6/1/2014	482.48	52.49	
32	pt245	2212988.53	6007153.17	51.67	ch1h20	6/1/2014	505.99	51.67	
33	pt246	2212995.39	6007162.96	51.34	ch1h20	6/1/2014	517.95	51.34	
34	pt247	2212999.39	6007168.69	50.96	ch1h20	6/1/2014	524.93	50.96	
35	pt248	2213008.03	6007180.61	51.31	ch1h20	6/1/2014	539.65	51.31	
36	pt249	2213017.15	6007194.78	52.04	ch1h20	6/1/2014	556.49	52.04	
37	pt250	2213023.91	6007203.47	52.31	ch1h20	6/1/2014	567.49	52.31	
38	pt251	2213029.74	6007212.28	54.57	ch1h20	6/1/2014	578.05	54.57	
39	pt252	2213035.34	6007219.87	55.23	ch1wsert	6/1/2014	587.48	55.23	
40	pt253	2213039.96	6007225.17	59.67	ch1rtbk	6/1/2014	594.48	59.67	
41	pt254	2213045.39	6007233.51	62.19	ch1rtbk	6/1/2014	604.42	62.19	
42	pt255	2213051.87	6007242.57	64.48	ch1rtbk	6/1/2014	615.55	64.48	
43	pt256	2213056.80	6007249.52	66.62	ch1rtbk	6/1/2014	624.08	66.62	
44	pt257	2213075.18	6007275.28	65.44	ch1rtbk	6/1/2014	655.72	65.44	

Cross section surveys should extend from endpoint to endpoint. If the cross section has obviously not changed in the upper bar area then old data can be used but the date of capture must be recorded.

Figure E5 Third page of cross section workbook: Post Extraction Monitoring survey.