Biological Assessment for Restoration Projects in Northern California

February 18, 2022

I. DESCRIPTION OF THE PROPOSED ACTION AND ACTION AREA

A. Discussion of Federal Action and Legal Authority / Agency Discretion

The Northern California Office of the NOAA Restoration Center (NOAA RC) and the San Francisco District of the U.S. Army Corps of Engineers (Corps) are requesting formal Section 7 consultation pursuant to the federal Endangered Species Act (ESA) (16 United States Code [U.S.C.] section 1531 through 1543) of 1973, as amended, for their restoration program in Northern California (Program). The NOAA RC will be the lead federal agency for regulatory consultation on, and implementation of, this Program. The Program consists of 1. the NOAA RC funding of eligible projects through a variety of ways including but not limited to, the Community Based Restoration Program, Office of Habitat Conservation Strategic Investments, and funding through other restoration programs that might develop during the term of this consultation, and (2) the Corps authorizing qualifying projects under their regulatory authorities [Section 404 of the federal Water Pollution Control Act, as amended Clean Water Act (CWA); Section 10 of the Rivers and Harbors Act of 1899; and Section 14 of the Rivers and Harbors Act of 1899, 33 U.S.C. 408 ("Section 408")]. A restoration project may be accepted into the Program if it receives NOAA RC funding, requires Corps regulatory authorization, or both.

B. Purpose and Objectives of the Proposed Action

The NOAA RC proposes to fund restoration projects within the jurisdiction of its Northern California Office (Humboldt, Del Norte, Trinity, Siskiyou, and part of Mendocino Counties in California and Klamath, Jackson and Lake Counties in Oregon) (Figure 1). The Corps proposes to issue permits for restoration projects in this same jurisdiction.

NOAA RC staff will administer and oversee the program to facilitate implementation of the restoration projects occurring within the NOAA RC's Northern California Office jurisdictional area. This Program includes restoration projects either funded by the NOAA RC, those that receive a Corps permit under the Program, or have both a Corps and NOAA RC nexus. All restoration projects included in the Program will be subject to the administration process described in the Oversight and Administration section below. Restoration projects may be submitted to the Program by either the Corps or the NOAA RC. The NOAA RC will take the lead for the Program, participate in the screening of individual projects under consideration for inclusion in the Program, and track implementation of individual projects. Such tracking will include documentation and reporting to the NMFS West Coast Region California Coastal Office (WCR CCO) of any adverse effects that result from individual projects under this Program.

C. Description of the Activities Included Under this Program

The Program will fund or authorize specific types of restoration projects, to be carried out using identified protection measures. For a restoration project to be included under the Program, it will have to meet the guidelines and best management practices outlined in this document, as determined through a review of each Program Application Form (Application) by the NOAA RC. Due to these multiple sideboards in the administrative process and the Program itself, adverse effects to listed species and their critical habitat will be avoided and/or minimized. Some loss of individuals of a listed species may occur during the construction of some Program projects. Overall the restoration projects implemented under this Program will help to recover threatened and endangered species and their critical habitat via long-term beneficial effects from habitat restoration, habitat enhancement, and increased ecosystem services.

Eligible Project Types

Improvements to stream crossings and fish passage - Projects to address upstream and downstream movement by fish and other species and improve connectivity of habitats.

Removal of small dams, tide gates, levees, bank revetments, and other legacy structures - Projects to improve fish and wildlife habitat, migration, tidal and freshwater circulation, flow, and water quality.

Riparian Restoration and Protection – Projects that stabilize banks while reducing fine sediment input, enhancing aquatic and riparian habitat, and improving water quality.

Restoration and enhancement of off-channel and side-channel habitat - Projects to reconnect and/or improve aquatic and riparian habitat for fish and wildlife.

Restoration and enhancement of tidal, subtidal, and freshwater wetlands - Projects to improve ecological functions.

Floodplain restoration - Projects including breaching and removal of levees, berms and/or dikes, resulting in hydrologic reconnection and revegetation, to improve ecosystem function through hydrological connection between streams and floodplains.

Water conservation projects for enhancement of fish and wildlife habitat - Projects such as off-stream storage tanks and ponds, including necessary off-channel infrastructure, to reduce low-flow stream withdrawals.

Removal of pilings and other in-water structures - Projects to improve water quality and aquatic habitat for fish and wildlife.

Removal of non-native terrestrial and aquatic invasive species and revegetation with native plants - Projects to improve aquatic and riparian habitat for fish and wildlife and improve other watershed functions.

Instream Restoration - Projects to restore functions of streams and riparian areas.

Upslope Watershed Restoration - Projects that enhance geomorphic processes and reduce anthropogenic sediment pulses.

D. Action Area

The action area is defined as all areas 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 includes all estuarine areas, stream channels, riparian areas, and hydrologically linked upslope areas that will be affected by the implementation of the proposed restoration projects that are authorized under the Program. Qualifying restoration projects occurring within the NOAA RC's Northern California Office jurisdiction (Humboldt, Del Norte, Trinity, Siskiyou, and part of Mendocino Counties in CA and Klamath, Jackson and Lake Counties in OR) will be implemented under the Program (figure 1). Most effects resulting from restoration activities will be restricted to the immediate restoration project site, while some activities may result in impacts to habitat or individual fish for a short distance downstream. The specific extent of effects from each project will vary depending on site conditions, project type, and specific project methods. Therefore, the Action Area for this Program is defined as all stream channels, estuarine habitats, riparian areas, wetlands, and hydrologically linked upslope areas within the NOAA RC's Northern California Office area jurisdiction (Figure 1) that encompasses the Eel and Mattole Rivers to the South and the Smith and Klamath Rivers to the North (including areas in Oregon for the Klamath River).

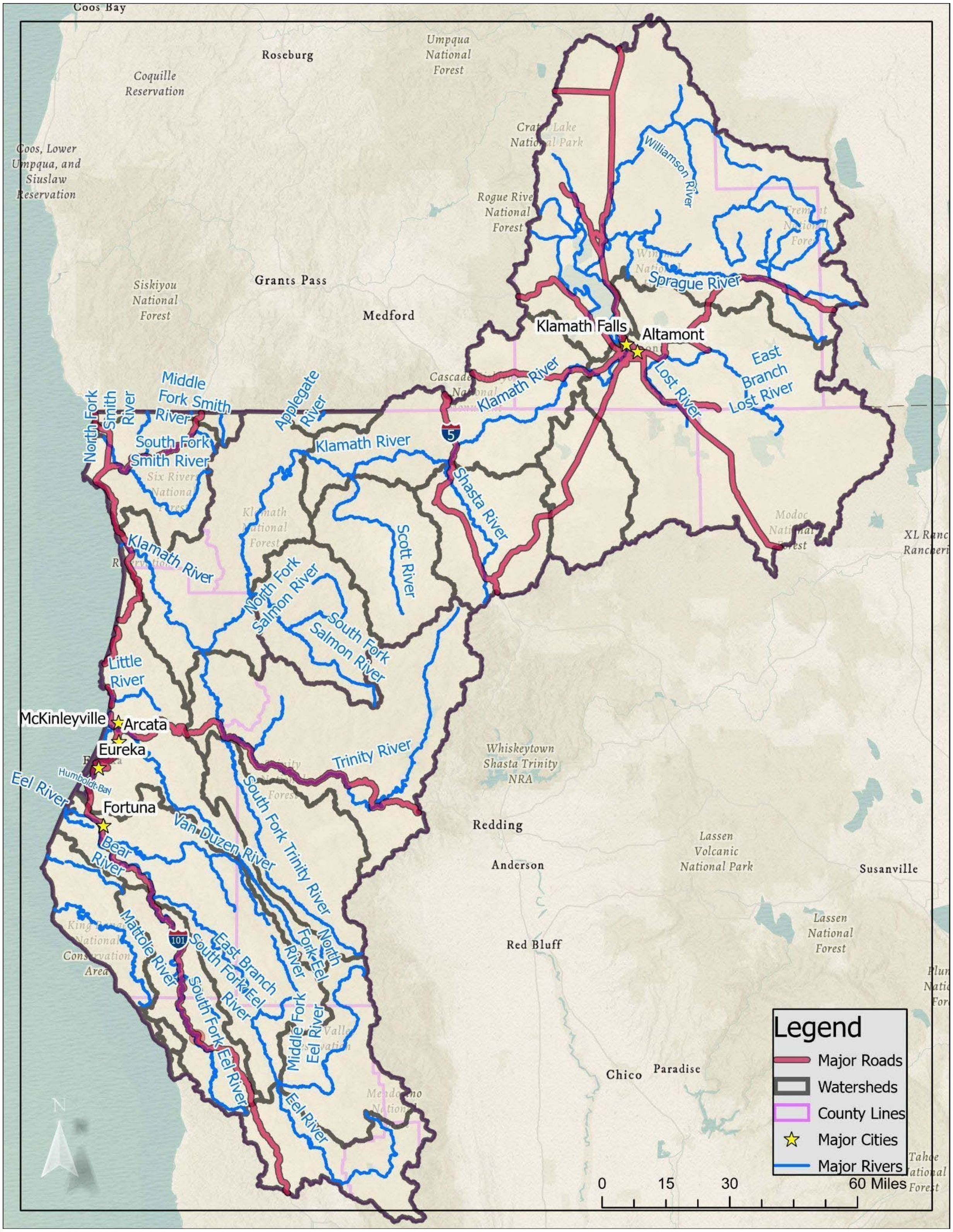

Figure 1. Action Area for the Northern California RC PBA

E. Program Administration

The NOAA RC will serve as the Lead Federal Action Agency responsible for ESA Section 7 compliance for this Program. Oversight and administration of the Proposed Program will be coordinated between NOAA RC, the Corps and WCR CCO to ensure that aquatic habitat restoration project Applications are submitted and evaluated for eligibility under the Proposed Program, and follow the necessary process for ESA Section 7 compliance.

Initial Project Screening and Technical Assistance

This PBA describes the Program requirements, developed collaboratively by NOAA RC, the Corps, and the WCR CCO which are designed to limit adverse effects while optimizing long-term benefits. These Program requirements are enacted through the administration of the Program, so that all restoration projects considered and included in the Program will be subject to the administration process, assessment, and review described in this section.

There are 3 pathways through which restoration projects included under this program will be identified, and this section describes the proposed procedures for each pathway.

The project Application or request for technical assistance comes to the NOAA RC first. The NOAA RC will be the first level of review in screening potential NOAA RC-funded projects, and projects for which applicants request NOAA RC technical assistance for authorization under the Program. Once the NOAA RC receives a request for technical assistance or an Application (see Submittal Requirements below), they will screen the project to determine eligibility and if it will require agency engineering review (see Engineering Review section below). If NOAA RC determines that the project is eligible for the program, they will notify the Corps that the review of the project has begun and provide the technical assistance request or application documents to the Corps.

The project Application or request for technical assistance comes to the Corps first. The Corps will be the first level of review in screening potential projects for authorization under the Program if they are the entity that receives a request for technical assistance or an Application for potential inclusion under the program (see Submittal Requirements below). The Corps will screen the project to determine eligibility and ask the RC for confirmation. If the RC concurs on eligibility, and if engineering review is required, the NOAA RC will coordinate this review with the appropriate agency engineer.

If the request for technical assistance comes to WCR CCO first as an individual consultation request. If WCR CCO receives a request for technical assistance or individual ESA S7 consultation that WCR CCO believes could be included under the Program, then WCR CCO will forward the available information to the NOAA RC for consideration and project consideration will proceed as though NOAA RC had received the Application first (see above). Applicant will fill out an application and send it to the RC.

Agency Technical Review

The project types needing agency technical review (which includes review by specialists in, e.g., fish passage, hydrologic, or fluvial geomorphology) include fish passage improvement, small dam removal, installation of fish screens, stage zero projects, and projects that include blasting or potential barotrauma effects. Many restoration projects that apply to this Program will have had agency technical review through the planning, design or funding phases of the project. If NOAA RC determines that the latest technical specifications for a project as described in the Application have been adequately addressed by prior agency technical review, NOAA RC will document the name of the reviewer and the date of review. If NOAA RC determines that the project still requires technical input, either because there has been no prior agency technical review or because that review was on different technical specifications, then NOAA RC will ensure that the appropriate agency technical review is completed. Due to limited agency technical resources at NMFS, the RC will also rely on restoration partner agency engineers and technical specialists to conduct these reviews. Agency technical reviews could be conducted by NMFS, CDFW, or USFWS engineers and technical specialists to ensure that the projects meet current guidelines and criteria as described in the PBA. The branch chief will be provided with a summary of the technical review already provided which they will either confirm or seek further evaluation for concurrence.

Confirmation of Project Inclusion

If the NOAA RC determines that a proposed project is eligible for the Program, the NOAA RC will notify the appropriate WCR CCO Branch supervisor of their findings and seek confirmation that the project is eligible to be included under the Program. The WCR CCO Branch Supervisor will be asked to respond within two weeks, notifying the RC of their confirmation or lack thereof. The NOAA RC will assume confirmation of eligibility if no response from the WCR CCO Branch Supervisor has been received within two weeks. If the WCR CCO Branch Supervisor responds within two weeks that s/he does not agree that the project is eligible, the applicant and the Corps will be referred back to the WCR CCO to work through the standard Section 7 process.

Once all necessary notices, approvals and confirmations are obtained through the process described above, the NOAA RC will email the project applicant, the Corps, the WCR CCO Branch supervisor that the project has been accepted into the Program and that programmatic ESA coverage has been issued. Within two weeks of this email, the NOAA RC will complete a Google spreadsheet with headings consistent with the current NMFS ECO spreadsheet so that the WCR CCO can meet their ECO responsibilities. NOAA RC will maintain copies of all correspondence in the Project File. Program applicants will be responsible for obtaining any other necessary permits or authorizations from appropriate agencies before the start of the project including, but not limited, to a State Water Quality 401 Certification, Lake and Streambed Alteration Agreement, California Endangered Species Act (CESA) take authorization, and local County permits. All applicants for projects included under this Program will ensure that NMFS and CDFW have access to these restoration project sites for 10 years post implementation to ensure that they are operating as described in the Programmatic Application Form.

Pre and Post Project Submittal Requirements

The new Programmatic Application Form has been included as part of the final PBA (Appendix I). This Application is not intended to describe every Best Management Practice (BMP), sideboard or minimization measure described in the PBO, but will include information regarding the major sideboards of the program including dewatering limits, fish removal and relocation, and in-water work windows. In addition, the Application will include information related to the pre-project Submittal Requirements below. Any projects that lack sufficient information to determine their appropriateness for inclusion in the Program will be returned to the project proponent for further clarification/development followed by revision and resubmission of the Application. Project Applications can be submitted throughout the year.

Pre-Project Submittal Requirements

The following information will be included in the Application for inclusion in the NOAA RC Arcata Office Programmatic Biological Opinion:

- Pre-project photo monitoring data
- Project description
- Does the project need agency technical review? If yes, who reviewed it?
- Project problem statement
- Project goals and objectives, etc.
- Description of the type of project and restoration techniques utilized (culvert replacement, instream habitat improvements, etc.).
- Description of construction activities anticipated and materials to be used (types of equipment, timing, staging areas or access roads required).
- If pile driving is part of the project, submit a pile driving plan and hydroacoustic analysis to confirm that underwater expected sound pressure levels are below thresholds for peak pressure and accumulated sound exposure levels. A hydroacoustic analysis is not required for vibratory sheet piles.
- If dewatering of the work site will be necessary, description of temporary dewatering methods including qualified individuals who will be onsite to relocate protected salmonids, and a relocation plan.
- Construction duration and start- and end-dates.
- Description of applicable minimization and avoidance measures incorporated into the individual project.
- Signed Project Application Form, verifying that they are agreeing to adhere to all conditions of the PBO during project design and implementation (Example in Appendix I).

Post Construction Reporting Requirements

By April 1 of the year following completion of construction of a project, each applicant will submit a completion report (RC Arcata Office Programmatic Biological Opinion Post-Project Monitoring Form) to the NOAA RC and the Corps that includes project as-built plans describing conditions immediately following completion of construction on the project and photo documentation of pre-project conditions and the site immediately after the project construction.

For projects including fish relocation, the report will also include all fisheries data collected by a qualified fisheries biologist, including the number of listed salmonids killed or injured during the proposed action, the number and age class of listed salmonids captured and removed, and any effects of the proposed action on listed salmonids not previously considered. If an applicant is also seeking a California Endangered Species Act Consistency Determination for a project that is included under this program, the California Department of Fish and Wildlife (CDFW) will also receive a copy of the post construction report described above.

Annual Report

In order to document the effects of Program-authorized projects on ESA-listed species and their critical habitat over the life of the Program, including tracking adverse effects to these species, by September 1, the RC will annually provide WCR CCO with, a report of the previous year's restoration activities that summarizes activities occurring under the Program during the most recent construction season, and conditions following completion of construction on projects. The annual report shall include a summary of the specific type and location of each project. The report shall include the following project-specific information, unless other information or presentation is mutually agreed upon between CCO and the RC prior to submission of report:

- A map indicating the location of each project.
- A description of the activities that occurred during implementation including the problems addressed by the project, timing, restoration techniques, unforeseen issues, restoration metrics (acres/miles restored), and anything else that will describe the work that has been completed during the implementation season.
- A summary of project objectives met.
- A summary across all projects, and by diversity stratum, of the number and species of fish relocated and killed, which refers to the take tables in the BO and shows the number taken in relation to the take authorized (Appendix II - PBO Reporting Table).
- A summary of any requested variances and their resolution.

Late-Arriving Federal Action Agencies

It is anticipated that other federal action agencies may need ESA Section 7 coverage for restoration projects either through a funding or land management nexus. Examples of potential Late-arriving Action Agencies (L-AAA) are BLM, BOR, NRCS, Forest Service, US Fish and Wildlife Service.), WCR CCO is responsible for consideration of requests from L-AAAs.

"The NOAA Restoration Center (RC) has reviewed the *(Project Proponent/applicant's)* Application to the NOAA RC's (Program Name) and has determined that *(Project)* fits within the scope of this program. NOAA RC and the United States Army Corps of Engineers' (USACE) have completed programmatic consultation with NMFS under section 7(a) (2) of the ESA for the NOAA RC's (*Program Name*). Please contact NMFS' Arcata Office to determine the ESA consultation requirements that may remain for your agency's project." NOAA RC will also send a copy of this response to WCR CCO each time this response occurs.

F. Eligible Project Types and Design Guidelines

Below are the detailed restoration project types included in the proposed Restoration Program. Each project type has a brief summary of the project purpose, a description of different activities and/or sub-project types, and a summary of typical construction, maintenance, and monitoring activities associated with the project type.

Although the Program does not cover projects whose primary purpose is creation or modification of non-restoration oriented infrastructure (e.g., dams and levees), some restoration projects may require creation, modification, or relocation of infrastructure so that travel, recreation, water supply or other types of infrastructure and operations can continue in the context of the restored habitat (e.g., relocation of a bridge or water control structure to allow for habitat restoration).

Improvements to stream crossings and fish passage

Improvements to stream crossings and fish passage, including fish screens, provide a number of ecological benefits. For example, they provide safe passage for migratory and non-migratory species, enhance beneficial transport of sediment and debris, and improve hydrology and hydraulics. Stream crossing and fish passage improvements must be consistent with NMFS' fish passage guidelines (NMFS 2001).

Stream Crossings, Culverts and Bridge Projects
Stream crossing, culvert, and bridge projects generally involve removing, replacing, modifying, retrofitting, installing or resetting existing culverts, fords, bridges and other stream crossings and water control structures of any size. This includes projects that are developed to upgrade undersized, deteriorated, or misaligned culverts.

Constructing or installing a stream crossing, culvert, or bridge may include site excavation, creation of rock ramps or roughened channels, weirs, adding fine and coarse grained streambed materials, formation and pouring of a concrete foundation and walls/abutments, and installation of the crossing structure, as well as placement of rock slope protection (RSP) to protect abutments, piers and walls.

Any crossing, culvert, or bridge that is part of the Program and intersects potential habitat for listed salmonid species must meet NMFS fish passage criteria. Only projects that meet stream simulation or active channel design metrics are included; projects that are considered hydraulic passage solutions (fishways, exposed concrete bottom, etc.) are not covered.

Design guidelines for this project type include:

- All stream crossing projects should consider storm-proofing guidelines presented in Flosi et al. (2010).
- Projects must follow the most recent NMFS guidelines for salmonid passage at stream crossings when implemented in currently occupied or potential anadromous habitat.

- Bridges and culverts will be designed to adequately convey flow and materials (e.g., the 100-year flood) in addition to allowing fish passage. If a bridge or culvert is designed to convey less than the 100-year design flow, the Project Applicant will demonstrate how the undersized culvert or bridge avoids excessive erosion/sedimentation, headcutting, or habitat impacts.
- Structures should be designed to provide passage for all life stages of salmonids. If this is not possible, the RC or Corps will work with WCR CCO engineers through the variance process established through the Environmental Services Branch for approval.
- Placement of RSP within the bankfull width of the stream will be avoided except for the minimum necessary for protection of bridge abutments and pilings, culverts, and other stream crossing infrastructure. The amount and placement of any RSP will not constrict the bankfull flow nor induce additional erosion in neighboring stream segments. The toe of RSP used for streambank stabilization will be placed sufficiently below the streambed scour depth to ensure stability
- Include minimal use of hard structures (e.g., wingwalls, footers) needed to maintain function of the passage facility. Structures that harden the channel should be placed outside the bankfull channel and/or buried to a depth below the lowest anticipated Vertical Adjustment Profile.

Fish Screens
This category includes the installationof fish screens on existing water intakes. Constructing/installing a fish screen usually includes site excavation, forming and pouring a concrete foundation and walls, and installation of the fish screen structure. Pile driving may be needed for certain types of screens. Typically, if the fish screen is placed within or near flood prone areas, rock or other armoring is installed to protect the screen. Fish screen types include: self-cleaning screens (including flat plate and other designs, including rotary drum screens and cone screens with a variety of cleaning mechanisms), and non-self-cleaning screens (including tubular, box, and other designs).

Design guidelines for this project type include:

- NMFS agency review is required for all fish screening projects.
- All fish screens must be consistent with the most recent NMFS fish screen design guidelines (NMFS, 1997).
- All fish screening projects will also provide a fish screen operations and maintenance plan along with their programmatic application form.

Removal of small dams, tide gates, and legacy structures

These projects are designed to reconnect stream corridors, floodplains and estuaries, establish wetlands, improve aquatic organism passage, restore more natural channel and flow conditions, restore fisheries access to historic habitat for spawning and rearing, and improve long-term aquatic habitat quality and stream geomorphology. All projects will be designed with seasonal construction considerations described in the instream work window section below, to minimize the potential adverse effects to water quality and/or aquatic species.

This project type involves removing small dams, tide gates, flood gates, and legacy structures to improve fish and wildlife migration, tidal and freshwater circulation and flow, and water quality. This project type may also include separation of streams from artificial impoundments (e.g., ponds or lakes) by realigning and/or rerouting channels around these artificial water bodies and/or through the use of vertical concrete or sheet-pile walls.

Removal of Small Dams

Small dams are removed to restore fish access to historic habitat for spawning and rearing and to improve long-term habitat quality and natural stream geomorphology. Types of eligible small dams include permanent, flashboard, debris basin, earthen, and seasonal-type dams that have the characteristics listed below.

Small dams included in the Program are defined by the California Division of Dam Safety (CDDS) as dams of non-jurisdictional size. Those dams are smaller in height and impounding capacity than those defined by (California Code 2010) where "dam" means:
Any artificial barrier [The Program is considering only dams with this definition] which is (a) less than 25 feet in height from the natural bed of the stream or watercourse at the downstream toe of the barrier, or from the lowest elevation of the outside limit of the barrier to the maximum possible water storage elevation and (b) was designed to have an impounding capacity of less than 2000 acre-feet.

Implementing small dam removal projects may require the use of heavy equipment (e.g., self-propelled logging yarders, mechanical excavators, backhoes, jackhammers, etc.) or explosives. Any use of explosives for small dam removal must be justified by site-specific conditions including equipment access difficulties and supported by analyses showing that potential harm is not greater than if heavy machinery were used. The analysis required is defined in the In-water Pile Driving Protection Measures section below.

Proposed Restoration Projects meeting any of the following conditions are ineligible for the Restoration Program:

- Projects involving dams under CDDS jurisdiction (eg. greater than 25 feet high and impound more than 2,000 acre feet of water);
- Projects in which sediments stored behind the dam have a reasonable potential to release accumulated harmful environmental contaminants [e.g.; dioxins, chlorinated pesticides, polychlorinated biphenyls, or mercury] beyond the freshwater probable effect levels summarized in the NOAA Screening Quick Reference Table guidelines (NOAA 2008); or
- Projects that require a more detailed analysis, based on the risk of significant loss or degradation of downstream spawning or rearing areas by sediment deposition.

Sites shall be considered to have a reasonable potential to contain contaminants of concern if they are adjacent to historical contamination sources such as lumber or paper mills, industrial sites, mining sites, or intensive agricultural production going back several decades (i.e., since chlorinated pesticides were legal to purchase and use). For sites that are found to have a reasonable potential for contaminants (ie. Cone burner or mill sites), project proponents should also assess the habitat downstream as well as within the reservoir sediments to determine if releasing contaminants will exceed background levels. Therefore, preliminary sediment sampling is advisable in these areas to determine if a project would be eligible for the Restoration Program.

Small dams that do not have historical contamination sources in the upstream watershed are considered to have low potential to contain contaminants and, therefore, would be considered low risk with reduced sediment sampling and evaluation.

This Program will only include dam removal that will result in formation of a channel at natural grade and shape upstream from the dam, naturally or with excavation, to optimize connectivity upstream and improve or minimize negative effects on downstream habitat. Dam removal projects accepted into the program where the downstream habitat is in excellent condition and will not benefit from sediment input will: (1) have a small volume of sediment available for release relative to the transport capacity of the stream channel, that when released by storm flows, will have minimal effects on downstream habitat as verified by a qualified engineer and are reviewed by NMFS engineers, or (2) be designed to remove sediment trapped by the dam down to the elevation of the target thalweg including design channel and floodplain dimensions.

Design guidelines for this project type include:
Use of one of the following two methods to restore the channel in a small dam removal project: Natural channel evolution or "stream simulation" design. The conditions under which each of these methods would be used are as follows:

Natural channel evolution: The natural channel evolution approach to restoring a channel bed would consist of removing all hardened portions (by hand efforts, heavy equipment, or explosives) of a dam and allowing the stream's flows to naturally shape the channel through the project reach over time. This method shall only be used in the following situations: (1) there are benefits of introducing sediment downstream and risks are minimal (or risks can be mitigated) to any of the downstream habitats and the aquatic organisms inhabiting them (based upon the amount and size gradation of the material being stored above the dam) if all of the sediment upstream of the dam is released during a single large storm event; (2) the project reach has sufficient space and can be allowed to naturally adjust based upon any land constraints with minimal risk to riparian habitat; (3) when possible, project implementation should follow procedures that have been documented as having been successfully performed elsewhere under similar circumstances; (4) notching the dam in increments after periodic storm events in order to reduce the amount of sediment being released during any individual storm event should have sufficient project funding in place to allow the dam to be completely removed within the Proposed Project timeframe.

Stream simulation: Stream simulation design relies upon trying to duplicate the morphological conditions observed within a natural reference reach throughout the project reach. Stream simulation designs should be used in extreme situations where excessive sediment releases pose a threat to downstream habitat and organisms. Specifically, the sediment upstream of the dam would be physically removed, and the channel through the excavated reach would be designed using stream simulation. Stream simulation designs would be conducted in accordance with known stream restoration guidance documents. This specifically includes: (1) the identification of a suitable reference reach; (2) quantification of the average cross-sectional shape, bank full width, channel slope, bed and bank sediment grain size distributions, and the geomorphic features of the channel (e.g., pool-riffle sequences, meander lengths, step pools, etc.); and (3) reproducing the geomorphic features found within the reference reach in the project reach.

Data Requirements and Analysis:

- Use of a longitudinal profile of the stream channel thalweg for at least a distance equal to 20 bankfull channel widths upstream and downstream of the project and long enough to establish the natural channel grade (as described in the CDFW Manual (Flosi et al. 2010).
- Determine the quantity and quality (grain size distribution and stratigraphy) of sediment stored in the reservoir, methods chosen on a case-by-case basis, with technical input from NMFS technical advisors.
- Depending on the quantity and caliber of sediment stored behind the dam, additional information may be needed to characterize the stored sediment relative to average annual sediment supply and transport capacity near the dam. Methods for estimating these rates should be selected in coordination with NMFS technical advisors.
- Use a habitat typing survey (CDFW Manual Part III, Habitat Inventory Methods) that maps and quantifies all downstream habitat units, including spawning areas that may be affected by sediment released by removal of the water control structure.
- For those projects that are intended to benefit from coarse sediment release to downstream reaches, assess whether additional channel structure is needed to help retain sediment (e.g., LWD and/or boulders) and estimate potential increases in spawning area.

Removal of Tide Gates and Flood Gates

Removal of, or upgrades to, existing tide and flood gates, that involve modifying gate components and mechanisms in tidal stream systems where full tidal exchange is incompatible with current land use (e.g., where backwater effects are of concern). Tide/flood gate replacement or retrofitting include such activities as installation of temporary cofferdams and dewatering pumps, excavation of existing channels, adjacent floodplains, flood channels, and wetlands, and may include structural elements such as streambank restoration and improving hydraulic roughness.

Placement of new gates where they did not previously exist are not eligible for the Restoration Program, with the following exceptions. Often during floodplain and estuarine restoration projects, new tide gates are required within the setback levees in order to protect critical infrastructure, and these types of structures are allowed in this Program. Replacing tide gates are eligible only if the Project can demonstrate that such replacement would significantly increase or enhance fish passage and meaningfully contribute to increases in tidal prism over the baseline condition. New tide gates that do not achieve or allow for full tidal restoration should provide offsetting conservation measures (for example, the installation of a large wood structure), as these new structures will result in long-term and often permanent effects.

Excavators, cranes, boats, barges, pumps, dump trucks, and similar equipment are typically used to implement the projects in this category.

Design guidelines for this project type include:

- For projects that constrain tidal exchange, the Project Applicant will ensure that the project increases fish passage opportunities and conditions for target species in areas of constrained tidal exchange. This Program will not support projects that further constrain tidal exchange as compared to current conditions.
- If a culvert and bridge will be constructed at the location of a removed tide gate, consider designing the structure to allow for full tidal exchange whenever possible.

Removal of Legacy Habitat Structures
This activity includes the removal of nonfunctioning in-channel and floodplain legacy habitat structures (e.g., grade control structures, boulder weirs, J-hooks, etc.) to improve water quality and channel geomorphology.

Excavators, cranes, boats, barges, pumps, dump trucks, vibratory pile drivers, and similar equipment are typically used to implement the projects in this category.

Design guidelines for this project type include:

- If the structure being removed contains material (i.e. boulders, LWD, etc.) not typically found within the stream or floodplain at that site, consider burying the material to raise the channel invert, if that is a goal of the project, or disposing of removed material at an approved landfill or disposal site.
- If the structure being removed contains material (i.e., large wood, boulders, etc.) that is typically found within the stream or floodplain at that site, the material can be reused to implement habitat improvements described under other restoration project types in the Restoration Program.
- If the structure being removed is keyed into the bank, consider filling in “key” holes with native materials to restore contours of the stream bank and floodplain. Fill material should be adequately compacted to prevent washing out of the soil during over-bank flooding. Material from the stream channel should not be mined to fill in “key” holes.

Riparian restoration and protection

These projects are intended to improve salmonid habitat through increased stream shading intended to lower stream temperatures, increase future recruitment of LWD to streams, and increase bank stability and invertebrate production. Riparian habitat restoration projects will aid in the restoration of riparian habitat by increasing the number of plants and plant groupings, and will include the following types of projects: natural regeneration, livestock exclusion fencing and crossings, off channel stock watering, bioengineering, non-native invasive vegetation removal, and revegetation. Part XI of the CDFG Manual, *Riparian Habitat Restoration,* contains examples of these techniques.

Revegetation with native plants should mimic the area’s naturally occurring wetland, riparian, or aquatic habitats and use seed or plant stock from the local watershed. Activities may include:

- Planting and seeding native trees, shrubs, and herbaceous plants
- Placing sedges, rushes, grasses, succulents, forbs, and other native vegetation
- Gathering and installing willow cuttings, stakes, bundles, mats, and fences
- Temporary irrigation

Reduction of instream sediment will improve fish habitat and fish survival by increasing fish embryo and alevin survival in spawning gravels, reducing injury to juvenile salmonids from high concentrations of suspended sediment, and minimizing the loss of, or reduction in size of, pools from excess sediment deposition.

Certain bioengineering techniques will be included under this Program including the planting of native plant materials, willow walls, willow siltation baffles, brush mattresses, and brush bundles. These techniques are intended to improve riparian and stream habitat by increasing stream shade to lower stream temperatures, increase the production of invertebrates, provide future recruitment of large woody material to streams, and trap and bind fine sediment to reestablish riparian areas. Bioengineering techniques use a minimal amount of hard materials (e.g., rock), but are not intended to include traditional hard engineering techniques. This Program does not include bioengineering techniques that use large amounts of rip rap or other hard materials that are intended to harden banks or prevent geomorphic processes from occurring to prevent erosion on private properties that are within the floodplain/river channel.
The use of boulders should be limited in scope and quantity to the minimum necessary to secure the toe of willow baffle trenches and will be buried below the active channel grade. This Program is not meant to cover projects that are merely protecting private property bank erosion issues.

Projects in this category may require the use of heavy equipment (e.g., self-propelled logging yarders, excavators, backhoes, dump trucks, etc.).

Design guidelines for riparian restoration and willow restoration includes:
- A site-appropriate revegetation plan will be developed as part of the project description at the project level.
- Design species palette for revegetation based on the species that naturally or historically occur in the project area, have the best chance of survival considering current site conditions, and can provide required habitat elements for fish.
- Revegetation that is not dependent on irrigation systems is generally preferred, however, there can be instances where irrigation is desirable. If using an irrigation system is necessary for plant establishment, the system must be installed and operational prior to planting, or prior to any periods where the weather forecast may jeopardize successful establishment of plants.
- Acquire native seed or plant sources as close to the project site as possible.
- For installation of pole cuttings, source cuttings from healthy plants, limiting collection to no more than 30% of individual plants or populations. Pole cuttings should be taken from live wood at least one-year-old or older.
- Plant cuttings when dormant and within 48 hours of collection.
- Enclose plantings with temporary fencing, cages, tubex or other protective measure, as appropriate, in areas where plantings are subject to browse by animals, such as deer, elk, beavers, livestock, gophers, or moles. Remove any non-biodegradable fencing material after plantings are adequately established.

Design guidelines for livestock fencing to protect, restore, or establish aquatic or riparian resources:

- Fence placement should be designed to allow for lateral movement of a stream, migration or dispersal of wildlife through the area, and establishment of riparian plant species. To the extent possible, fences should be placed outside the channel migration zone, the area along a river within which the channel(s) can be reasonably predicted to migrate over time as a result of natural and normally occurring hydrological and related processes. Install cross-stream fencing at fords, with breakaway wire, swinging floodgates, hanging electrified chain, or other devices to allow the passage of floodwater and large woody material during high flows.
- Avoid and minimize vegetation removal when constructing fence lines to the extent feasible. Large, established riparian vegetation should not be removed.

Design guidelines for livestock stream crossings and watering lanes to protect, restore, or establish aquatic or riparian habitat:

- Design and construct essential livestock stream crossings to handle reasonably foreseeable flood risks, including associated bedload and debris, and to prevent the diversion of streamflow out of the channel and down the livestock trail that uses the crossing, if the crossing fails. Livestock crossings will not create barriers to upstream and downstream passage of adult and juvenile fish.
- Use existing access roads and stream crossings whenever possible, unless new construction would result in less habitat disturbance and the old trail or crossing is retired. Locate new livestock stream crossings or water lanes where streambanks are naturally low. Avoid placement of stream crossings in or near sensitive aquatic habitats.
- Minimize the number of stream crossings for livestock within a single reach and across a watershed for livestock to limit vegetation disturbance and erosion.
- When locating livestock crossing and watering lanes, ensure the existing fences, pasture access, grazing patterns, shoreline slope and water depth is appropriate. The ramp should be wide enough to accommodate the expected usage but not less than 12 feet and not steeper than 3:1.
- Extending the ramp in the waterway far enough to achieve the desired depth and ensure the approach surface runoff is diverted away from the ramp. If side slopes will be the result of improving the lanes, make sure the cut or fills are not steeper than 2 horizontal to 1 vertical.
- The surface material should be an angular drainage rock and the use of fencing or other barriers is required to delineate the boundaries of the ramp to keep cattle out of the surrounding riparian areas and limit entrance into the active channel.
- Keep the ramps away from shaded river areas and follow the general avoidance and minimization measures included at the end of this document. Design guidelines for off-channel livestock watering to protect, restore, or establish aquatic or riparian habitat
- Withdrawals for livestock watering must not dewater habitats, cause streamflow conditions that adversely affect Covered Species, or significantly reduce habitat value.
- Each livestock water development should have a float valve or similar device, a return flow system, a fenced overflow area, or similar means to minimize water withdrawal and potential runoff and erosion.

- If water intakes are placed in native fish-bearing streams, screen surface water intakes to meet current NMFS and CDFW fish screening guidelines. Screens should be self-cleaning, or regularly maintained by removing debris buildup. A responsible party will be designated to conduct regular inspection and as needed maintenance to ensure that pumps and screens are properly functioning.
- Troughs or tanks should be placed far enough from a stream or surrounded with a protective surface to prevent mud and sediment delivery to the stream. Steep slopes and areas where compaction or damage could occur to sensitive soils, slopes, or vegetation due to congregating livestock should be avoided.
- Part X of the CDFW Manual, Upslope Assessment and Restoration Practices, describes methods for identifying and assessing erosion, evaluating appropriate treatments, and implementing erosion control treatments.

Restoration and enhancement of off-channel and side-channel habitat

Restoring and enhancing off-channel and side-channel habitat features helps to improve aquatic and riparian habitat for fish and wildlife. This project type has the following benefits:

- Increases habitat diversity and complexity
- Improves hydrologic and hydraulic diversity or complexity
- Provides long-term nutrient storage and substrate for aquatic macroinvertebrates
- Moderates flow disturbances and protects communities
- Increases retention of leaf litter
- Provides refuge for fish during high flows

Projects proposed for side-channel or off-channel habitat also typically improve hydrologic connection between main channels and their floodplains.

This project type typically involves reconnecting side-channel, alcove, oxbow, pond, off-channel, floodplain, and other habitats, and potentially removing off-channel fill, berms and plugs. This activity category typically applies to areas where side channels, alcoves, and other backwater habitats have been filled or blocked from the main channel, disconnecting them from most if not all flow events.

Work may involve removing or breaching levees, berms, and dikes; excavating channels; constructing wood or rock tailwater control structures; and constructing large wood and boulder habitat features.

This project type can involve the use of logs or boulders as stationary water level control structures. With the exception of off stream storage projects to reduce low-flow stream withdrawals, projects involving the permanent installation of a flashboard dam, head gate, or other mechanical structure are not eligible for the Program.

The creation of new side-channel, alcove, oxbow, and pond habitats is included. New side-channels and alcoves will be constructed in geomorphic settings that will accommodate such features.

Excavators, bulldozers, dump trucks, front-end loaders, and similar equipment may be used to implement projects.

Design guidelines for this project type includes:

- Excavated material removed from off- or side-channels will be 1) reused onsite to enhance riffles and grade controls to increase connectivity if it is the appropriate grain size range or can be screened to appropriate size range, or 2) hauled to an upland site for disposal, or 3) spread across the adjacent floodplain, as long as the soil is considered suitable for application (e.g., free of contaminants and/or pathogens), and is done so in a manner that does not restrict floodplain capacity or otherwise degrade floodplain function.

Floodplain restoration

Project types in this category enlarge key salmonid rearing habitat and improve the diversity and complexity of river-wetland corridors that include aquatic, meadow, and riparian habitat, as well as first order ecosystem functions, because they have the following effects:

- Drive primary productivity which is the foundation of the food web
- Provide expansive areas of food-rich low velocity habitat that supports large numbers of juvenile salmonids
- Provide resilient habitat during high stress events such as floods and wildfire, and refuge from predators
- Provide thermal complexity and buffering due to the connectivity of the hyporheic zone, that offers multiple habitat niches within close proximity
- Deliver food resource benefits on site as well as downstream from floodplain return flows
- Provide numerous additional ecosystem benefits such as sediment, carbon, debris and water storage, which supports riparian vegetation, bird and mammal use, Create dynamic hydrological connection between streams and floodplains that salmonids evolved with
- Increase floodway capacity (reducing downstream flood impacts) and the frequency and duration of floodway inundation.
- Reduce or eliminate legacy areas (such as gravel pits) that strand native fish or provide habitat for nonnative predatory fish, or both.
- Reset valley floors to stage zero

Floodplain restoration projects involve either 1) removing barriers (such as setback, breaching, and removal of levees, berms and dikes, 2) excavation of elevated surfaces to reconnect to the channel, or 3) or channel fill for hydraulic reconnection, and combinations of these approaches to create streams that are fully-connected with their floodplains and typically multi-threaded, or 'stage zero' (see Cluer and Thorne 2013).

These projects generally involve reconnecting historical stream and river channels and freshwater deltas with floodplains, and reconnecting historical estuaries to tidal influence, through levee removal, setback and breaching, or construction of floodplain surfaces that connect at base flow. Typically, these projects take place where floodplains and estuaries have been disconnected from adjacent streams and rivers. Levee setback projects include construction of new levees to facilitate removal or breaching of existing levees and creation of aquatic or riparian habitat. These project types may also include filling and/or reshaping of on- and off-channel gravel pits and channels. Levees may be adjusted or a low levee bench may be created to allow for tidal inundation or channel margin habitat.

Meadow and floodplain restoration may involve reconnecting down-cut channels to their floodplains to restore hydrologic processes and meadow health by filling incised, entrenched channels with local material such as undifferentiated sediment from nearby banks or legacy berms, creating new stream channels, re-grading floodplains (which involves skimming earth off higher areas and moving it into lower areas), realigning channels, or installing water surface elevation structures.

These restoration actions may be implemented to completion through construction and earth moving techniques, or through kick-starting physical processes complete work over time to restore a channel network and floodplain that supports forested wetlands or grasslands. It follows that a multi-year multi-step process would be a necessary part of proposals that intend to rely on process-based incremental methods.

Similar to restoration projects that create off-channel/side-channel habitats, proposed floodplain restoration projects will include information regarding consideration of water supply (channel flow, overland flow, and groundwater), water quality, and reliability; and tolerance for an enlarged dynamic river corridor including channel changes.

Heavy equipment such as excavators, bulldozers, dump trucks, front-end loaders, and similar equipment may be used to implement these projects when valleys are being reset. Low tech methods such as beaver dam analogs (and similar), constructed riffles, beaver introduction, may be used when incremental process-based methods are used.

Design guidelines for channel reconstruction, valley reset, or relocation projects include:

- Design actions to restore floodplain inundation characteristics by modifying channel capacity through a combination of parameters, including elevation, width, sinuosity gradient, length, and roughness--in a manner that closely mimics or resets those that would naturally occur at that stream and valley type.
- To the extent feasible, native materials (rock, gravel, large wood, sod, willows, topsoil, etc.) should be salvaged and utilized as channel fill.
- Non-native fill material may be reused if it is of similar quality to native material, or removed from the channel and floodplain to an upland site or appropriate offsite disposal location, potentially including a landfill (for anthropogenic debris).
- Where practicable, construct geomorphically appropriate elevations, stream channels, and floodplains (e.g. enable natural transport processes including the creation of depositional and scour features) within a watershed and reach context to connect channels.
- When necessary, de-compact soils once overburden material is removed. Overburden or fill composed of pathogen-free and native materials, which originated from the project area, may be used within the floodplain to support the project goals and objectives.
- Significant areas of restored floodplain should remain hydraulically connected during base flow conditions.

Design guidelines for projects that involve setback or removal of existing berms, dikes and levees:

- Design actions to restore floodplain activation characteristics in a manner that closely mimics, to the extent possible, those that would naturally occur in that area.
- Where it is not possible to remove or setback all portions of dikes and berms, openings may be created with carefully planned breaches. Timing and spacing of breaches should be planned for maximum positive environmental outcomes.
- Bare surfaces should be treated with LWD placement and/or replanted using native plants

Establishment, restoration, and enhancement of tidal, subtidal, and freshwater wetlands

Establishing, restoring and enhancing tidal, subtidal, and freshwater wetlands results in increased primary and secondary production and diversification and increased aquatic habitat for a diversity of fish and wildlife species.

This project type generally involves grading (e.g., creating depressions, berms, and drainage features) and/or breaching (e.g., excavating breaks in levees, dykes, and/or berms) to create topography and hydrology that:

- Supports native marsh plants (planted or recruited naturally)
- Provides habitat elements for target species
- Provides other targeted wetland functions
- Allows fish and other aquatic species to use channel networks and marsh plains with hydrologic variability (seasonally or tidally)

This project type also creates ecotones (transitional zone between two habitat or community types [aquatic and upland interface]), ‘horizontal levees’, and/or setback berms) and/or “living shorelines” that use fill and excavation with native vegetation (submerged and/or emergent), alone or in combination with offshore sills (e.g., artificial reefs), to stabilize the shoreline. Creation of ecotones could require extensive beneficial fill and have the potential to affect adjacent existing wetlands. However, these projects are necessary to allow tidal wetlands to respond to sea level rise, provide refuge for native wildlife, and buffer wetlands from adjacent municipal and industrial land uses.

Living shorelines provide a natural alternative to ‘hard’ shoreline stabilization methods like stone sills or bulkheads, and provide numerous ecological benefits including water quality improvements, fish and invertebrate habitat, and buffering of shoreline from waves and storms. Living shoreline projects use a suite of habitat restoration techniques to reinforce the shoreline, minimize coastal erosion, and maintain coastal processes while protecting, restoring, enhancing, and creating natural habitat for fish and aquatic plants and wildlife.
This project type includes excavation, removal, and/or placement of fill materials to restore or approximate pre-disturbance site conditions; contouring wetlands to establish more natural topography, hydrology, and/or hydraulics; and setting back, modifying, or breaching existing dikes, berms and levees.

This project category also includes the following actions:

- Constructing transitional tidal marsh habitat (i.e., “horizontal levees,” setback berms, or ecotones)
- Backfilling artificial channels

- Removing existing drainage structures, such as drain tiles
- Filling, blocking, or reshaping drainage ditches to restore wetland hydrology
- Establishing tidal/fluvial channels and wetlands in tidal waters where those wetlands previously existed, or have migrated or will migrate as a result of sea level rise
- Installing structures or fill necessary to establish wetland or stream hydrology
- Constructing nesting/planting islands
- Constructing open water areas
- Constructing noncommercial, native oyster habitat (e.g., reefs) over an un-vegetated bottom in tidal waters
- Conducting noncommercial, native shellfish seeding
- Establishing submerged aquatic vegetation (e.g., eelgrass beds) in areas where those plant communities previously existed

Activities needed to establish vegetation, including plowing or disking for preparation of seedbeds and planting appropriate wetland species, and use of seed buoys are also included. Project activities that plan for climate change, including sea level rise, will be considered in tidally influenced locations. California's Climate Adaptation Strategy recommends using ecotones and living shorelines as a potential adaptation method to reduce the need for engineered "hard" shoreline protection devices and to provide valuable, functional coastal habitat (CNRA 2018). The California State Coastal Conservancy's Climate Change Policy also supports the use of living shorelines for their ability to improve the resiliency of estuarine habitat to future sea level rise and other related effects of climate change.

Ecotone habitat levees should be used when new exterior levees are required to protect adjacent landowners from the return of tidal inundation. The project side of the levee should be constructed with areas of longer gentle slopes to accommodate upland refugia for sensitive salt marsh and brackish marsh species during future flood king tides. Interior berms should be disconnected from the adjacent uplands to reduce access by predators during high tides. In addition, side cast material should be used during the excavation of new channels to re-contour pond bottoms to achieve the desired hydrology, including creating islands disconnected from uplands to provide future upland refugia and nesting areas in larger marshes.

Excavators, graders, bulldozers, dump trucks, front-end loaders, boats, barges, and similar equipment may be used to implement projects

Design guidelines for this project type include:

- Implement projects to repair or restore estuary functions, while not putting adjacent landowners at increased flood risk once dikes/levees are breached and the project area is flooded.
- Where possible, recreate historic channel morphology that supports wetland function. Channel designs should be based on aerial photograph interpretation, literature, topographic surveys, and nearby undisturbed channels. Channel dimensions (width and depth) should be based on measurements of similar types of channels and the drainage area.
- Removal of temporary access roads and de-compaction of soils as necessary to support desired revegetation.

- Restore wetlands to elevations necessary to support the desired vegetation communities, accounting for anticipated natural sediment accumulation and future sea level rise. Appropriate dredge material or other clean fill material may be imported to raise subsided landscapes, depending on the desired habitat to be restored. Overfill may be necessary to accommodate settling.

If grading of intertidal plane (landform) is needed, implement the following guidelines, to the extent feasible, to avoid and/or minimize adverse effects to water quality, sensitive resources, and/or Covered Species:

  - conduct all grading of tidal plane in dry conditions, behind cofferdams, dikes, and/or levees;
  - After grading of the tidal plane is complete, implement water management activities to revegetate and stabilize exposed soils on the plane prior to removing cofferdam and/or breaching dikes or levees;

Implement the following pre-breach water management measures:

- Release on-site water gradually; water from the project area should be released gradually to reduce the effect of potentially low dissolved oxygen (DO) and high temperature water on the surrounding water body; this would allow the plume of degraded water to dissipate without harmful effects to aquatic life.
- For projects that include the use of donor vegetation beds for use in restored marsh and/or emergent or submerged vegetation sites, no more than five percent of the below ground biomass of an existing donor bed should be harvested for transplanting purposes. Plants harvested should be taken in a manner that thins an existing bed without leaving any noticeable bare areas. Harvesting of flowering shoots for seed buoy techniques should occur only from widely separated plants and only a certain percent of the donor stock should be used per year. This percent is site dependent and prior to restoration requires intimate knowledge of the genetics and population dynamics of the donor site.
- Shellfish substrate should be placed to encourage oyster larval recruitment. Restoration sites are typically subtidal or intertidal on un-vegetated, soft bottom estuarine areas. Rarely, substrate may be placed on hard substrate that represents former reef habitat, but only if the hard substrate is not currently producing oysters at a sustainable level. Natural substrate (oyster or clam shells) is preferred due to the oysters' affinity for it, but is not always available. Shells are most often deployed loose or in mesh bags. Artificial substrate should be used when there is not enough shell substrate available to create larger reef areas or when the bottom substrate is unstable and substantial sinking of the reef is likely to occur. Common artificial substrates include limestone rock and baycrete (e.g., Reef Balls, Oyster Castles, etc.). Regardless of type, most substrate is deployed from a boat or barge, but in some shallow water situations, restoration practitioners and community volunteers may carry the substrate to the reef location.
- Restoration efforts could also include releasing live shellfish in the restoration area if the local population is not large enough to produce viable larvae or has been fully extirpated from the area. Oysters may be released as single oysters, or already attached to substrate as oyster spat on shell. Non-reef-forming organisms such as clams and abalone are released as individuals, but may be caged as necessary to (e.g., to reduce predation) and facilitate research efforts. Rearing shellfish prior to release occurs in land-based or near-

shore aquaculture facilities. Some shellfish are purchased from commercial facilities, but some funding recipient organizations run their own facilities as well.

- Shell sources – shell or other substance used for substrate enhancement should be procured from clean sources that do not deplete the existing supply of shell bottom. Shells should be left on dry land for a minimum of one month before placement in the aquatic environment. Shells from the local area should be used whenever possible.
- Native species and disease – Shellfish species native to the project area should be used where possible. Any shellfish transported across state lines or grown through an aquaculture facility should be certified disease free.

Water conservation projects for enhancement of fish and wildlife habitat

Creation, operation, and maintenance of water conservation projects, including off-stream storage tanks and ponds and associated off-channel infrastructure and rainwater harvest systems, reduce low-flow stream withdrawals and enhance stream flows, particularly base flows for fish and wildlife habitat during the dry season. These projects typically require placing infrastructure (e.g., pumps and piping, fish screens and head gates) in or adjacent to the stream to provide alternative water intake facilities. Other projects in this category include piping ditches to create a more efficient use of water where the water saved will be dedicated to fish and wildlife under State Water Code Section 1707 or forbearance agreements. These projects are designed to improve streamflow and riparian habitat for fish and wildlife. Excavators and other heavy equipment may be used to implement projects.

Tailwater is created in flood irrigation operations as unabsorbed irrigation water flows back into the stream. Restoration projects to address tailwater input will construct tailwater capture systems to intercept tailwater before it enters streams. Water held in capture systems, such as a pool or a pond, can be reused for future irrigation purposes, thereby reducing the need for additional stream withdrawals.

All water conservation projects in the Program will require diverters to agree to forbearance or dedication, and verify compliance with water rights — as conditioned by a small domestic use or livestock stockpond registration, appropriative water right, or a statement of riparian water use registered with the State Water Resources Control Board and reviewed for compliance by the NOAA RC and the Corps.

Design guidelines for this project type include:

- Design storage volumes so that water diverters have sufficient storage capacity to cover intended domestic, irrigation, or livestock needs during the no-pump time periods for drier than average years (e.g., dry season droughts. The no-pump time period should be based on the season, local conditions, forbearance agreement, and existing studies if available. These projects will require a technical review.
- All pump intakes must be screened in accordance with current NMFS fish screen criteria.

- All water conservation projects will ensure that any water saved will remain instream for fish and wildlife benefits either through forbearance agreements or the State Water Board’s 1707 process.

- All water conservation projects need to be associated with legal water rights recognized by the State Water Board or a local water master for watersheds that are adjudicated via decree.

- Tailwater collection ponds that do not incorporate return channels to the creek will be located far enough from the edge of the active channel to not likely cause stranding of juvenile salmonids during flood events.

- Tailwater captured and re-used shall be done to reduce stream withdrawals, an in-lieu of use. No new ground shall be put into production due to tailwater re-use.

Removal of pilings and other in-water structures

Untreated and chemically treated wood pilings, piers, vessels, boat docks, and derelict fishing gear, and similar structures built using plastic, concrete and other materials may be removed to improve water quality and habitat for fish and wildlife. These projects are designed to remove contaminant sources and hazards from stream, river, and estuary habitats. These projects are intended to cover only the removal of debris or structures and not the replacement of any structures or pilings. The removal of any pilings in estuarine waters under this Program requires compliance with the California Eelgrass Mitigation Policy (CEMP), to ensure that eelgrass resources are not affected by the project.

Equipment such as boats, barges, excavators, dump trucks, front-end loaders, and similar equipment may be used to implement these projects.

Design guidelines for this project type includes:

Design guidelines for projects that involve removing an intact pile:

- In areas where eelgrass is found within and around the project site, conduct work at high tides with sufficient depths in order to ensure that any impacts to submerged aquatic vegetation via propeller wash, or vessel groundings are avoided. Projects must demonstrate compliance with the CEMP.
- Install a floating surface boom to capture floating surface debris, as necessary.
- Dislodge the piling with an excavator bucket (through pushing and pulling) or vibratory hammer, whenever feasible. Avoid intentionally breaking a pile by twisting or bending.
- Slowly lift piles from the sediment and through the water column.
- Place chemically treated piles in a containment basin on a barge deck, pier or shoreline without attempting to clean or remove any adhering sediment. A containment basin for the removed piles and any adhering sediment may be constructed of durable plastic sheeting with sidewalls supported by hay bales or another support structure to contain all sediment.
- Fill the holes left by each piling with clean, native sediments located from the project area if available, as needed.

- Dispose of all removed piles, floating surface debris, any sediment spilled on work surfaces, and all containment supplies at a permitted disposal site.
- Pile cutting should be considered a last resort, following multiple attempts to fully extract piling using other methods. If cutting piles, piles should be cut below the mudline to provide more habitat and ensure that as much debris is removed as possible. Areas with low levels of contamination, wave and/or currents conducive to mixing (i.e., high-energy environments), and/or small numbers of piles removed may not need to be cut to prevent remobilization of contaminants.

Design guidelines for projects that involve removing a broken pile:

- If a pile breaks above the surface of uncontaminated sediment, or less than two feet below the surface, every attempt short of excavation should be made to remove it entirely.
- If a pile breaks above presumed, or known contaminated sediment, saw the stump off at the sediment line; if a pile breaks within contaminated sediment, make no further effort to remove it and cover the hole with a cap of clean substrate appropriate for the site, as applicable.

Instream restoration

Instream restoration provides the following benefits:

- Habitat complexity, diversity, and cover for wildlife species
- Increased spawning and rearing habitat
- Improved pool habitat and pool-to-riffle ratios
- Increased sinuosity
- Improved water quality

These projects may include the following activities:

- Placing large woody material or boulders
- Constructing engineered logjams
- Installing small wood structures or beaver dam analogues
- Beaver restoration
- Augmenting and placing gravel
- Stream channel reconstruction
- Removing revetment and other streambank armoring materials
- Improving stream morphology and channel dynamics; restoring sediment input and retention balance; and improving water quality

Project activities may also include excavating, sorting, placing, and contouring existing on-site materials (e.g., historic mine tailings) on perched floodplains and in channels to reconnect those habitats and improve spawning and rearing conditions.

Project types in this category typically occur in areas where channel structure is lacking due to past stream cleaning (large woody material removal), riparian timber harvest, historic grazing and meadow dewatering practices, hydromodification, urbanization, and in areas where natural gravel supplies are low due to anthropogenic disruptions. These projects would occur in stream channels and adjacent floodplains to increase channel complexity, rearing habitat, pool formation, spawning gravel deposition, channel complexity, hiding cover, low velocity areas, and floodplain function. Equipment such as helicopters, excavators, dump trucks, front-end loaders, full-suspension yarders, and similar equipment may be used to implement projects.

Engineered logjams are large wood structures that include an anchoring system, such as rebar pinning, ballast rock, or vertical posts. These structures are designed to redirect flow and change scour and deposition patterns, and are patterned after stable natural log jams. They are anchored in place using rebar, rock, or piles (driven into a dewatered area or the streambank, but not in water). Engineered log jams create a hydraulic shadow, which is a low-velocity zone downstream that allows sediment to settle out. Scour holes develop adjacent to the engineered logjam.

Large woody material may be installed using either anchored and/or unanchored logs, or both, depending on site conditions and wood availability. Wood loading methods may include but are not limited to direct felling, whole tree tipping/placement, or tree placement by helicopters, grip hoisting, or excavator, and other etc.

Creation of beaver habitat and installation of beaver dam analogue structures, including installation of in-stream structures to encourage or simulate beaver dam building and shunting of flows onto floodplain surfaces may be designed in association with stream and riparian habitat projects.

In-channel structures consist of porous channel-spanning structures consisting of biodegradable vertical posts (beaver dam support structures) approximately 0.5 to 1 meter apart and at a height intended to act as the crest elevation of an active beaver dam. Variation of this restoration treatment may include post lines only, post lines with wicker weaves, construction of starter dams, reinforcement of existing active beaver dams, and reinforcement of abandoned beaver dams.

Beaver Habitat Restoration - The long-term goal of this category is to restore linear, entrenched, simplified channels to their previously sinuous, structurally complex channels that were connected to their floodplains. This will result in a substantial expansion of riparian vegetation and improved instream habitat. Beavers, which were historically prevalent in many watersheds, build dams that, if they remain intact, will substantially alter the hydrology, geomorphology, and sediment transport within the riparian corridor. Beaver dams will entrain substrate, aggrade the bottom, and reconnect the stream to the floodplain; raise water tables; increase the extent of riparian vegetation; increase pool frequency and depth; increase stream sinuosity and sediment sorting; and lower water temperatures.

In addition, infrastructure along streams and in riparian areas may be removed or relocated. The primary purpose of infrastructure removal is to eliminate or reduce impacts on riparian areas and vegetation, reduce erosion, reduce sedimentation into adjacent streams, and provide for native revegetation or natural native plant recruitment. Some examples of the types of infrastructure that could be removed or relocated are boat docks, boat haul out locations, campgrounds, campsites, day-use sites, roads/trails, and off-highway/off-road vehicle routes that impact aquatic resources or riparian habitat.

Design guidelines for these project types includes:

- Where appropriate, the CDFW Manual and Fluvial Habitat Center at Utah State, Low-Tech Process-Based Restoration Design Manual (http://lowtechpbr.restoration.usu.edu/) should be consulted during the planning and design process.
- For the purposes of large wood placement, trees can may be felled or pulled/pushed over, if tree felling does not significantly degrade the riparian habitat, create excessive stream bank erosion, destabilize stream banks, create temperature increases in water bodies, or concentrate surface runoff, or increase the likelihood of channel avulsion during high flows.
- Where feasible, retain trees killed through fire, insects, disease, blow-down, and other means. Retain snags and trees with broad, deep crowns ("wolf" trees), damaged tops, or other abnormalities that may provide a valuable wildlife habitat component.
- Stabilizing or key pieces of large wood must be intact, hard, with little decay, and if possible have root wads (untrimmed) to provide functional refugia habitat for fish.
- Place large wood and boulders in areas where they would naturally occur and in a manner that closely mimics natural accumulations for that stream type. For example, boulder placement may not be appropriate in low gradient meadow streams. Engineered logjams should be patterned, to the greatest degree possible, after stable natural log jams in the project area, either present or historical.
- Project design should simulate log jams, debris flows, wind throw, tree breakage, and other disturbance events to the greatest degree possible using techniques including, but not limited to, log jams, debris flows, wind throw, and tree breakage.
- If large wood anchoring is required, a variety of methods could be used. These include buttressing the wood between riparian trees, the use of or using manila, sisal, or other biodegradable ropes for lashing connections. If hydraulic conditions warrant the use of structural connections, cable, duckbills, rebar pinning or bolted connections could be used but this approach should be generally avoided unless no other options exist. Clean rock could be used for ballast but is limited to the minimum size or weight needed to anchor the large wood.

Design guidelines for stream channel reconstruction

In situations where excessive sediment releases from the project site or surrounding watershed currently pose a threat to downstream habitat and organisms (ie. stage zero projects and large (>100 acre) floodplain restoration projects), use stream simulations following USFS Stream Simulation Design to inform the project design. Stream simulation designs should:

- Identify a suitable reference reach and survey a longitudinal profile
- Quantify the average cross-sectional shape, bankfull width, bed and bank sediment grain size distributions, and the geomorphic features of the channel (e.g., pool-riffle sequences, meander lengths, step pools, etc.); and
- Reproduce the geomorphic features found within the reference reach in the project reach.

Design guidelines for gravel augmentation

- Only augment gravel in locations where the natural supply has either been eliminated, significantly reduced through anthropogenic disruptions, or where it can be used in conjunction with other projects, such as off-channel habitat or floodplain restoration.

- Size gravel with the proper gradation for the stream, using non-angular rock. When possible use gravel of the same lithology as found in the watershed.
- Gravel should not be mined from the floodplain in a manner that would cause stranding during future flood events. Only use imported gravel that is free of invasive species and non-native seeds.
- Gravel should be placed directly into the stream channel, at tributary junctions, or other areas in a manner that mimics natural gravel deposition.

Upslope Watershed Restoration

Sites in upslope and riparian watershed areas may be restored to reduce delivery of sediment to streams, promote natural hydrologic processes, and restore wildlife habitat and improve water quality. This project type also includes road- and trail-related restoration, including decommissioning, upgrading, and storm-proofing. The following are some of the specific techniques that may be used:

- Removing, installing, or upgrading culverts
- Constructing water bars and dips
- Deep ripping decommissioned roadbeds
- Reshaping road prisms
- Vegetating cut slopes and roadbeds
- Removing and stabilizing side-cast materials
- Grading or resurfacing roads and trails that have been improved for aquatic restoration, using gravel, bark chips or other permeable materials
- Shaping the contours of the road or trail base
- Replacing road fill with native soils
- Installing new culverts under trails or roads to reduce ditch length
- Stabilizing the soil and tilling compacted soils to establish native vegetation.

These actions target priority roads and trails that contribute sediment to streams or disrupt floodplain and riparian functions. Equipment such as excavators, bulldozers, dump trucks, and front-end loaders, may be used to implement these projects.

Design guidelines for road and trail erosion control and decommissioning

- Road and trail erosion control and decommissioning shall use the Handbook for Forest, Ranch and Rural Roads: A Guide for Planning, Designing, Constructing, Reconstructing, Upgrading, Maintaining and Closing Wildland Roads (Weaver et. al 2015) and any subsequent editions.
- When demolishing or removing road segments immediately adjacent to a stream, use BMP’s including sediment control barriers between the project and stream.
- Where feasible, existing vegetative buffers along access roads or trails should be used to avoid or minimize runoff of sediment and other pollutants to surface waters.
- Minimize disturbance of existing native vegetation in ditches and at stream crossings.
- Space the drainage features used for storm proofing and erosion treatment projects in such a manner as to hydrologically disconnect road surface runoff from stream channels. If grading and resurfacing are required, use clean, permeable materials for resurfacing.
- Dispose of slide and waste material in stable sites out of the flood-prone area. Clean material may be used to restore natural or near-natural contours.

- For projects within riparian areas, recontour the affected area to mimic natural floodplain contours and gradient to the extent possible.
- For permanent decommissioning of roads, complete excavation of stream crossing fills, including 100-year flood channel bottom widths and stable side slopes. Excavate unstable or potential unstable sidecast and fill slope materials that could otherwise fail and deliver sediment to a stream. Perform road surface drainage treatments (e.g., ripping, outsloping, and/or cross draining) to disperse and reduce surface runoff.

Design guidelines for road relocation

- When a road is decommissioned in a floodplain and future vehicle access through the area is still required, relocate the road away from the stream, as far as is practical. New road construction should be outside waters of the U.S. or any other aquatic habitat suitable for Covered Species.

G. Restoration Effectiveness Monitoring

The NOAA RC has been providing a beneficial service to the restoration community by advancing restoration science through pre- and post-project effectiveness monitoring on restoration projects throughout northern California. For the past 11 years, these efforts have been authorized through the CA Department of Fish and Wildlife's ESA 4d program, but based on the suggestion from WCR CCO staff, the Restoration Center has decided to include these monitoring efforts in the Program.

The NOAA RC has limited staff and resources to conduct pre-project assessment and post-project effectiveness monitoring and will not be monitoring every project that we cover under this Program. We anticipate that monitoring will occur on some projects that will either be funded via the NOAA RC or permitted by the Corps, as well as projects that are either being planned or implemented through other funding sources (state, federal, tribal, etc…). The NOAA RC anticipates that approximately 10 projects per year could be monitored for pre implementation and up to 8 projects per year could be monitored for post project effectiveness.

Because this Program is a long term effort and it is difficult to anticipate where and when the RC will be able to conduct this effectiveness monitoring, we have described the general purpose of monitoring, potential monitoring methods, the potential locations of these activities, and a limit on the amount of fish trapped, netted, or otherwise captured, handled, and released in each population.

Purpose of effectiveness monitoring

Pre-Assessment Monitoring

When planning restoration projects, a lack of information regarding species occurrence, distribution and density during different parts of the year often confound project design objectives. Knowing site-specific fish presence/absence information during the summer and winter can help inform design elements and help determine if the feature will be used only for winter rearing, summer rearing, or both. The NOAA RC is proposing to conduct this monitoring in coordination with other partners.

Post Project Monitoring
In order to determine the effectiveness of the project, the NOAA RC proposes to determine species utilization, timing and duration of use, and in certain cases, growth rates of target species utilizing the project area. PIT tags will be used to determine growth rates, residency times and apparent survival. Tissue samples will be provided to the SWFSC for genetic analysis, when requested and scale samples will be provided to CDFW, when requested.

Monitoring Methods

Many project types including, but not limited to estuary restoration, BDAs, off channel habitat creation and floodplain reconnection projects will be monitored to estimate the effectiveness of these efforts. Many of these projects will be monitored for both summer and winter habitat utilization. Monitoring efforts may be conducted from the first significant rainfall (Oct-Nov) through spring (April-June) for winter rearing projects and also during summer base flow season (June-Oct) to determine summer rearing. In addition to the biological monitoring, habitat conditions (temp/salinity/DO) may be spot checked during sampling events as well.

Snorkel Surveys:
Snorkel surveys are conducted to determine an overall presence/absence for a given area. Surveys may be conducted pre- and post-project when conditions allow. Survey crews would consist of 1-2 divers counting salmonids swimming upstream using a 4 pass bounded count methodology for population estimates or single pass surveys for presence/absence surveys in water that has at least 3 feet of visibility.
Procedure Used: Observe Only

Seining:
Seining is conducted to capture salmonids in deeper water that does not have significant complexity (eg. LWD).Two consecutive seine hauls are conducted at a given location using a 30ft x 4ft knotless mesh nylon seine. Nets consist of 6mm mesh wing sections 9m in length and a 3mm mesh 2m x2m bag section. The seine is set by 2-3 crew members in a round haul fashion by fixing one end on the bank while the other end is deployed, wading upstream and returning to shore in a half circle. Once the lead line approaches the shore it is withdrawn more than the cork line until fish are corralled in the bag and the lead line is on the bank. Each haul is expected to take approximately 1 - 5 minutes. Fish captured in the bag are kept submerged in water until they are transferred by dip net, separated, and placed in aerated 5-gallon buckets following each haul prior to processing. Sampling will cease if water quality conditions are unfavorable to the health of the fishes or if temperatures exceed 21°C.
Procedures Used: Seine, measure, weigh, anesthetize, PIT tag, capture, handle, release.

Minnow Traps:
Minnow trapping is typically used in very complex habitats where seining would likely not be successful due to small/large wood and significant aquatic vegetation. Galvanized 5mm square wire mesh minnow traps will be baited with iodine soaked roe and set. The minnow traps are 430mm in length with a middle circumference of 760mm and fyke openings of 25mm at both ends. Traps are fished at each site on the bottom of the channel next to habitat structures if possible. Soak time of individual traps ranges from 30 to 180 minutes. Sampling will cease if

water quality conditions are unfavorable to the health of the fishes or if temperatures exceed 21 C.
Procedures Used: Trap, measure, weigh, anesthetize, PIT tag, capture, handle, release.

Fyke Nets:
Fyke nets will be used in off channel and slow water habitats when minnow traps and seining are found to not be effective. Fyke Nets (size, 1/4 in mesh) may be set in the afternoon in a pond with the entrance/exit blocked so that no fish may enter or leave. Fyke nets are set overnight and checked the following morning. The same methods will be repeated approximately 1 or 2 days following the first trapping event. Fyke nets have an opening at the mouth up to 15 feet wide and narrow down to a small opening approximately 6 inches wide and up to 20 feet in length. Fyke nets are set in the deepest part of the pond and would not be used in flood flows or when temperatures exceed 21 C.
Procedures Used: Trap, measure, weigh, anesthetize, PIT tag, capture, handle, release.

Electrofishing:
Electrofishing will be used in low water conditions when stream habitat is too complex for seining or minnow traps, or those methods are not effective to inform the monitoring question. All electrofishing will be conducted according to NMFS Guidelines for Electrofishing Waters Containing Salmonids listed under the Endangered Species Act (2000). Electrofishing activities will be conducted during periods of the day or when water is coolest. All electrofishing and handling procedures will be consistent with electrofishing methods and guidelines described below which describes fish relocation activities, except fish would not be relocated from the habitat where they were found during effectiveness monitoring. After handling, fish will be released in the same pool they were captured. Electrofishing will not be used in high flows or when temperatures exceed 18 C.

Handling Methods

Anesthetic:
Fish will be closely observed in an anesthetic bath of Alka –Seltzer Gold (aspirin free) brand sodium bicarbonate ($NaHCO_3$) until loss of equilibrium is achieved but operculum movement is still present. Concentrations will range from 1 to 2 tablets per gallon of fresh river water depending on fish size and water temperature. The bicarbonate material will be allowed to completely dissolve before fish are added to the anesthetic bath.

Fry and juveniles will be anesthetized in groups < 10 fish per batch and larger parr and smolts will be anesthetized in groups of 2 fish. Salmonids should be able to be handled after 1-2 minutes in the anesthetic bath and will be processed immediately following loss of equilibrium. Fish will be allowed to recover in 5 gallon buckets of aerated fresh river water until normal behavior is observed. Water temperature in the recovery bucket will be monitored and maintained to be within 2 degrees of the ambient river temperature. Fish will be released to slow water habitat in the location in which they were originally found.

Measure/Weigh:
While anesthetized, individuals will be placed onto a wetted Plexiglas measuring board and measured to the nearest mm fork length, then transferred to a wetted container on an electronic scale and weighed to the nearest 0.01g.

PIT Tagging:
Anesthetized fish greater than or equal to 70mm FL may be implanted with tags up to 12mm, fish 60mm FL to 69mm FL may be implanted with up to 9mm tags, and fish <60mm would not be tagged. A full duplex PIT tag that is surgically implanted into the body cavity of the fish will be used as described by Prentice et al. (1990). A small incision would be made with a sterile scalpel anterior to the pectoral fin and the tag would be inserted by hand into the body cavity of the fish. Recovery protocols would follow as above to allow for full recovery before release.

Tissue Sampling:
Tissue sampling techniques such as fin-clipping are common to many scientific research efforts using listed species. All sampling, handling, and clipping procedures have an inherent potential to stress, injure, or even kill the fish. This section discusses tissue sampling processes and its associated risks.

Fin clipping is the process of removing part of a fish's fin to either mark the fish or to collect genetic material for analysis. Although researchers have used all fins for marking at one time or another, the current preference is to clip the adipose, pelvic, or pectoral fins. Marks can also be made by punching holes or cutting notches in fins, severing individual fin rays (Welch and Mills 1981). Many studies have examined the effects of fin clips on fish growth, survival, and behavior. The results of these studies are somewhat varied; however, it can be said that fin clips do not generally alter fish growth.

Measures to Minimize Effects of Effectiveness Monitoring

Snorkel surveys would be the predominant method of assessing fish presence and absence, whenever feasible. Where there is an interest in collecting growth data or to implant PIT tags to track movement and survival, fyke, seining, and minnow trapping efforts would be considered. If fish handling is desired, data collection crews will be large enough to reduce the impact of handling on salmonids to the greatest extent possible. Captured fish will be placed in buckets of river water with thermometers to verify temperature is consistent with environmental temperatures and a portable aerator to keep DO levels up to acceptable levels. During high flows minnow traps will be set in areas of slow water refugia. All PIT tagged fish will be anesthetized before PIT tag implantation. All fish will be returned to the habitat where they were collected.

II. Protection, Avoidance and Minimization Measures

Prohibited Activities

The following activities are not within the scope of the Proposed Restoration Program, are not analyzed in this BA, and will require separate authorization:

- Removal of any dam under Federal Energy Regulatory Commission (FERC) jurisdiction.
- Use of gabion baskets.
- Use of chemically treated timbers used for grade or channel stabilization structures, bulkheads, overwater structures, or other instream structures.
- Construction of new fish ladders
- With the exception of storage projects to reduce low flow stream withdrawals (see Section 4.3.5, Water Conservation), off-channel/side-channel habitat projects that require the installation of a flashboard dam, head gate, or other mechanical structure.
- Use of riprap, RSP or any other form of bank protection, other than the minimum amount needed to achieve restoration project goals.
- Projects that are likely to cause, for any Covered Species, a permanent net loss of habitat, permanent net loss of habitat function, or permanent net loss of functional value of designated or proposed critical habitat (e.g., the physical and biological features essential for the species' recovery and conservation).
- Projects that would result in any net loss of eelgrass resources

Limits on Area of Disturbance for Individual Projects

Stream Dewatering
A maximum of 1,000 contiguous feet of that stream reach may be dewatered at any given time. Other sections of stream within the same project area may be dewatered in up to 1,000 foot increments, as long as listed fish that were handled during the initial dewatering event are not handled during subsequent dewatering events during the same year. To avoid handling the same fish multiple times during sequenced dewatering events, fish must be relocated to suitable habitat conditions outside of the zone that could be dewatered during that season. In addition, for each dewatering and relocation event, sufficient field staff must be available to efficiently move and care for relocated fish. The fish relocation plan submitted prior to the event must describe this sufficiency.

General Construction Season
The general construction season will be from June 15 to November 1. Restoration, construction, fish relocation, and dewatering activities within any wetted and/or flowing creek channel shall only occur within this period. Extensions to this work season can be granted if: 1. There is less than a 50% chance of 1.5 inches of rain predicted over any 24 hour period during the granted time extension, and 2. The RC determines, and NMFS confirms, that an extension will not result in effects that go beyond those analyzed during the ESA consultation on the Program, either in type or magnitude.

Limits on Project Frequency and Location
Our 2012 PBA suggested limiting the number of sediment-producing projects based on watershed size to reduce the potential cumulative effects of turbidity in each stream. Based on our collective experience observing many of these projects after the first rains of the season, we are not including the same sediment-producing project limit as we did in 2012 in this PBA because we believe that the BMPs provided in this PBO are protective enough to prevent turbidity that will negatively affect listed fish. In addition to the erosion control BMPs that are described in our proposed action, we propose to reduce the effects of turbidity by limiting

floodplain reconnection projects over 100 acres, and small dam removals, to one project, per HUC-12, per year.

General Conservation Measures

A number of conservation measures are being incorporated into the proposed action (the Program). All conservation measures incorporated into the proposed action are to be considered original elements of the proposed action, and are evaluated as a whole in the BA's effects analysis.

The purpose of conservation measures is to incorporate design refinements and best practices into the proposed action to avoid and/or minimize potential effects. These best practices tend to be relatively standardized; they represent sound and proven methods to reduce the potential effects of an action. The rationale behind including these commitments is that the Program's project applicant(s) will undertake and implement the applicable and necessary measures below as part of any proposed project. Although these best practices are required for restoration projects authorized under the Program, specific measures may be altered, added or removed on an individual project basis with the approval of the NOAA RC and Corps, in coordination with NMFS.

- Work shall not begin until: (a) the Corps and/or NOAA RC has notified the applicant that NMFS has not objected to incorporating the project into the Program (i.e. the requirements of the ESA have been satisfied), and (b) all other necessary permits and authorizations are finalized.
- All materials placed in or over streams, rivers or other waters shall be nontoxic. Any combination of wood, plastic, cured concrete, steel pilings, or other materials used for in-channel structures shall not contain coatings or treatments or consist of substances toxic (e.g., copper, other metals, or pesticides, petroleum-based products, etc.) to aquatic organisms that may leach into the surrounding environment in amounts harmful to aquatic organisms.
- Water containing mud or silt from construction activities shall be treated by filtration or retention in a settling pond to avoid draining sediment-laden water back to the stream channel. Alternatively, an infiltration area may be created and used within the regular project footprint or in upland areas, if the soil composition of the area adequately supports infiltration back into the system.
- Screens shall be installed on all water pump intakes and other water withdrawal structures in compliance with NMFS salmonid-screening specifications.
- Construction supervisors and managers will be educated on weed identification and the importance of controlling and preventing the spread of invasive weeds. Equipment will be cleaned of any sediment or vegetation at designated wash stations before entering or leaving the project area to avoid spreading pathogens or non-native invasive species. The Project Applicant will follow the guidelines in the CDFW's California Aquatic Invasive Species Management Plan (CDFW 2008) and Aquatic Invasive Species Disinfection/Decontamination Protocols (CDFW 2016).
- Construction equipment such as portable equipment, vehicles, and supplies, including chemicals, shall be stored at designated construction staging areas or on barges, exclusive of any riparian or wetland areas. Any equipment that may leak shall be stored over

impermeable surfaces, if available, and drip pans (or any other type of impermeable containment measure) will be placed under parked machinery and checked and replaced when necessary, to prevent drips and leaks from entering the environment.
- Where possible, poured concrete should be excluded from contact with surface or groundwater during initial curing, ideally for a period of 30 days after it is poured. During that time, runoff from the concrete will not be allowed to enter the surface or groundwater. If this is not feasible due to expected flows and site conditions, commercial sealants that are appropriate for use near water may be applied to the poured concrete surface to prevent exposure of uncured concrete to streamflow and subsequent risk to water quality and aquatic life before the sealant comes into contact with flowing water. If sealant is used, water will be excluded from the site until the sealant is dry and fully cured according to the manufacturer's specifications. Concrete is considered to be cured when water poured over the surface of concrete consistently has a pH of less than 8.5.
- Areas for fuel storage, refueling, and servicing of construction equipment must be located in an upland location and following industry BMP's.
- The contractor/applicant to the Program shall inspect, maintain and repair all erosion control materials and devices prior to and after any storm event, at 24 hour intervals during extended storm events, and a minimum of every two weeks until all erosion control measures are no longer needed.
- Immediately after project completion and before the close of the seasonal work window, all exposed soil shall be stabilized with erosion control measures such as mulch, seeding, and/or placement of erosion control blankets. Where straw, mulch, or slash is used on bare mineral soil, the minimum coverage shall be 95 percent with two inch minimum depth.

Dewatering Activities and Fish Relocation Protection Measures

The following protection measures apply to all projects where dewatering and fish relocation activities occur:

- In those specific cases where it is deemed necessary to work in flowing water, the work area shall be isolated and all flowing water shall be temporarily diverted around the work site to maintain downstream flows during construction. The contiguous length of the dewatered stream channel, and the duration of any single dewatering event, shall be minimized to the greatest extent practicable.
- Before beginning project work, a dewatering and fish capture and relocation plan will be submitted to the NOAA RC or the Corps as an additional part of the project description, so that any activities involving the handling of protected fishes may be reviewed and modified if necessary.
- Fish shall be excluded from the work area by blocking the stream channel above and below the work area with fine-meshed block nets or screens. Mesh openings will be no greater than 1/8 inch. The bottom of a seine must be completely secured to the channel bed. Screens must be checked twice daily, or more frequently as needed, and cleaned of debris to permit free flow of water. Block nets shall be placed and maintained throughout the dewatering period at the upper and lower extent of the areas where fish will be removed. Block net mesh shall be sized to ensure salmonids upstream or downstream do

not enter the areas proposed for dewatering. Net placement is temporary and will be removed once dewatering has been accomplished or construction work is complete for the day.

- Prior to dewatering, the best means to bypass flow through the work area shall be determined to minimize disturbance to the channel and avoid direct mortality of fish and other aquatic vertebrates. Project site dewatering shall be coordinated with a qualified biologist, who will perform fish and amphibian relocation activities. The qualified biologist(s) must be familiar with the life history and identification of listed salmonids and listed amphibians within the action area. The qualified biologist shall submit a CV to the NOAA RC for approval prior to fish relocation activities. Prior to dewatering a construction site, the qualified biologist shall capture and relocate fish and amphibians to avoid direct mortality and minimize adverse effects. Plastic/rubber material shall be placed over sandbags used for construction of cofferdams to minimize water seepage into the work area. Coffer dams and stream diversion systems shall remain in place and fully functional throughout the construction period. When coffer dams with bypass pipes are installed, debris racks will be placed at the bypass pipe inlet. Bypass pipes will be monitored a minimum of two times per day, seven days a week. All accumulated debris shall be removed.
- Bypass pipes will be sized to accommodate, at a minimum, twice the expected baseflow. The work area may need to be periodically pumped dry of seepage. Pumps will be placed in flat areas, well away from the stream channel, and secured by tying off to a tree or stake in place to prevent movement by vibration. Pumps shall be refueled in an area well away from the stream channel and fuel absorbent mats will be placed under the pumps while refueling. Pump intakes shall be covered with mesh per the requirements of NMFS Fish Screening Criteria to prevent potential entrainment of fish or amphibians that could not be removed from the area to be dewatered. The pump intake shall be checked periodically for impingement of fish or amphibians. If pumping is necessary to dewater the work site, procedures for pumped water shall include requiring a temporary siltation basin for treatment of all water prior to entering any waterway and not allowing oil or other greasy substances originating from operations to enter or be placed where they could enter a wetted channel. Screen openings shall not exceed 1/4 inch (6.35 mm) in the diagonal direction and approach velocities should not exceed 1ft/second. Velocities should be minimized by placing screens in slow water conditions either in a pool or in a constructed backwater area.
- When construction is complete, the flow diversion structure shall be removed as soon as possible in a manner that will allow flow to resume with the least disturbance to the substrate. Cofferdams will be removed so surface elevations of water impounded above the cofferdam will be reduced at a rate that will minimize the probability of fish stranding as the area upstream becomes dewatered.
- All seining, electrofishing, and relocation activities shall be performed by a qualified biologist. All qualified biologists need to be experienced in fish identification, have experience with fish removals and relocations and have an understanding of the water quality needs of fish. The qualified biologist will need to submit a CV to the NOAA RC for approval prior to fish relocation activities. The qualified biologist shall capture and relocate listed species prior to construction of the water diversion structures (e.g., cofferdams). The qualified biologist shall note the number of listed species observed in

the affected area, the number and species of fish relocated, where they were relocated to, and the date and time of collection and relocation.

- The qualified biologist will adhere to the following requirements for capture and transport of listed fish species:
    - At some sites with low habitat complexity, herding fish with a single seine pass before the block net is installed can help reduce the number of fish that must be handled.
    - Determine the most efficient means for capturing fish (e.g., seining, dip netting, trapping, and electrofishing). Complex stream habitat generally requires the use of electrofishing equipment, whereas in outlet pools, fish may be concentrated by pumping-down the pool and then seining or dip-netting fish.
    - NOAA RC (staff identified as project contact) shall be notified one week prior to capture and relocation of listed fish to provide the NOAA RC an opportunity to monitor the operation.
    - In streams with high water temperature, perform relocation activities during morning periods, when water is coolest.
    - Prior to capturing fish, determine the most appropriate release location(s). Consider the following when selecting release site(s): Similar water temperature as capture location, ample habitat for captured fish, low likelihood of fish reentering work site or becoming impinged on exclusion net or screen.
    - All electrofishing will be conducted according to NMFS Guidelines for Electrofishing Waters Containing Salmonids listed under the Endangered Species Act (2000) with the exception of the temperature maximum meant to address research projects, and instead electrofishing should be performed in the early morning.
    - Water temperature, dissolved oxygen, and conductivity shall be recorded in an electrofishing log book, along with electrofishing settings.

The following methods shall be used if fish are removed with seines: A minimum of three passes with the seine shall be utilized to ensure maximum capture probability of salmonids within the area. All captured fish shall be processed and released prior to each subsequent pass with the seine. The seine mesh shall be adequately sized to ensure fish are not gilled during capture and relocation activities.

The following methods shall be used during relocation activities associated with either method of capture (electrofishing or seining) for salmonids:

- Salmonids shall not be overcrowded into buckets; allowing no more than 150 0+ fish (approximately six cubic inches per young-of-the-year [0+] individuals approximately) per five gallon bucket and fewer individuals per bucket for larger fish.
- Every effort shall be made not to mix (0+) salmonids with larger salmonids, or other potential predators. Have at least two containers and segregate (0+) fish from larger age classes. Larger amphibians shall be placed in the container with larger fish.
- Native salmonid predators collected and relocated during electrofishing or seining activities shall be relocated in a dispersive manner so as to not concentrate them in one area. Particular emphasis shall be placed on avoiding relocation of predators into steelhead and salmon relocation pools. To minimize predation on salmonids, these

species shall be distributed throughout the wetted portion of the stream so as not to concentrate them in one area.

- All captured listed fish shall be relocated outside of the proposed construction site and placed in suitable habitat. Captured fish shall be placed into a pool, preferably with a depth of greater than two feet with available instream cover.
- All native captured fish will be allowed to recover from electrofishing and anesthesia before being returned to the stream.
- Temporarily hold fish in cool, shaded, aerated water in a container with a lid. Provide aeration with a battery-powered external bubbler. Protect fish from jostling and noise and do not remove fish from this container until time of release.
- Place a thermometer in holding containers and, if necessary, periodically conduct partial water changes to maintain a stable water temperature.

In-water Pile Driving Protection Measures

Pile driving will mostly be conducted in, or adjacent to, dry channels. If pile driving cannot occur in a dry channel, fish will be removed using the techniques described above and project applicants shall implement the following measures to avoid and minimize potential adverse effects that could otherwise result from in-water pile-driving activities:

- Project applicants shall develop a plan for pile-driving activities to minimize impacts to fish and will allow sufficient time in the planning and construction schedule for coordination with regulatory agencies. If water depths allow for hydrophones, pile driving will cease before injury levels are exceeded regardless of what kind of attenuation, dewatering, or fish relocation measures are implemented. Impact pile driving that exceeds the Interim Pile Driving Criteria (June 2008) listed below (or current Pile Driving Criteria when 2008 criteria are updated) is excluded for inclusion:

  Peak pressure = 206 dBpeak
  Accumulated sound exposure levels = 183 dB cSEL
  Accumulated sound exposure levels for fish over 2g = 187 dB cSEL

  The 183 dB cSEL level will be used unless, through the variance process defined below, salmonids under 2 grams are determined to be absent. The number of piles, type/size of the piles, estimated sound levels caused by the driving, how many piles will be driven each day, and any other relevant details on the nature of the pile driving activity must be included in the project application. See Technical Guidance for the Assessment of Hydroacoustic Effects of Pile Driving on Fish (2020) Caltrans Hydroacoustic Manual for more information on assessment techniques https://dot.ca.gov/-/media/dot-media/programs/environmental-analysis/documents/env/hydroacoustic-manual.pdf
- Pile driving shall occur during the established/approved in-water and general work windows (see above).
- Sheet piling shall be driven by vibratory or nonimpact methods (i.e., hydraulic) that result in sound pressures below threshold levels to the extent feasible.
- Pile driving activities shall occur during periods of reduced currents. Pile-driving activities shall be monitored to ensure that the effects of pile driving on protected fish

species are minimized. If any stranding, injury, or mortality to fish is observed, NMFS shall be immediately notified and in-water pile driving shall cease. Vibratory hammers, rather than impact hammers, shall be used whenever possible.

- If pile driving is implemented in, or adjacent to, a wetted stream or estuary, monitoring of fish shall occur during pile-driving activity to ensure no fish stranding or mortality occurs.
- Sound monitoring will be done, if monitoring is possible due to water depth, to ensure that cSEL injury levels are not exceeded. If levels are met, then pile driving shall cease for a minimum of 12 hours. Attenuation measures include the following:
  - A cushioning block could be used between the hammer and pile
  - A confined or unconfined air bubble curtain shall be used.

Vegetation/Habitat Disturbance Protection Measures

The following protection measures apply to all projects where vegetation/habitat disturbance occurs:

- Vegetation disturbance will be avoided and minimized to the extent practicable. Disturbed areas will be revegetated with plant species appropriate to the site.
- Disturbance to existing grades and native vegetation shall be limited to the actual site of the project, necessary access routes, and staging areas. The number of access routes, the size of staging areas, and the total area of the project activity shall be limited to the minimum necessary to achieve the project goal. All roads, staging areas, and other facilities shall be placed to avoid and limit disturbance to streambank or stream channel habitat as much as possible. When possible, existing ingress or egress points shall be used and/or work shall be performed from the top of the creek banks or from barges on the waterside of the project levee. Following completion of the work, the contours of the creek bed and creek flows shall be returned to pre- construction conditions or improved to provide increased biological functions.
- If removal of vegetation is required within project access or staging areas, the disturbed areas shall be replanted with native species, and the area will be maintained and monitored for a period of two years after replanting is complete to ensure the revegetation effort is successful. The standard for success is 60% survival of plantings or 80% ground cover for broadcast planting of seed, after a period of two years. Any non-biodegradable fencing materials shall be removed after plantings are adequately established. If revegetation efforts will be passive (i.e., natural regeneration), success will be defined as total cover of woody and herbaceous material equal to or greater than pre-project conditions.
- Prior to construction, locations and equipment access points will be determined to minimize riparian disturbance. Unstable areas will be avoided. Project designs and access points to be used should minimize riparian disturbance without affecting less stable areas, to avoid increasing the risk of channel instability.
- Soil compaction will be minimized by using equipment with a greater reach or that exerts less pressure per square inch on the ground than other equipment, resulting in less overall area disturbed or less compaction of disturbed areas.

Dredging Operation Protection Measures

The Project Applicant will develop and implement a dredging operations and dredging materials management plan to minimize the effects that could occur during dredging operations and material reuse and disposal. The plan will describe a sampling program for conducting physical and chemical analyses of sediments before disturbance. It also will describe BMPs to be implemented during dredging operations. BMPs might include(e.g., using less intrusive dredging procedures, properly containing dredging spoils and water, using silt curtains, using methods to minimize turbidity, and timing dredging activity to coincide with low flows). The plan also will describe methods to evaluate the suitability of dredged material for reuse and disposal.

Herbicide Use Protection Measures

The following protection measures apply to all projects where herbicide application is anticipated as a project activity.

- Whenever feasible, reduce vegetation biomass by mowing, cutting, or grubbing it before applying herbicide to reduce the amount of herbicide needed.
- Chemical control of invasive plants and animals will only be used when other methods are determined to be ineffective or infeasible. Herbicide use will be evaluated on a project-by-project basis with consideration of (and preference given toward) integrated pest management (IPM) strategies wherever possible. See University of California statewide IPM Program for guidance documents (http://ipm.ucanr.edu/index.html). Chemical use is restricted in accordance with approved application methods and BMPs designed to prevent exposure to non-target areas and organisms. Any chemical considered for control of invasive species must adhere to all regulations, be approved for use in California, its application must adhere to all regulations per the California Environmental Protection Agency, and it must be applied by a licensed applicator under all necessary state and local permits. Use herbicides only in a context where all treatments are considered, and various methods are used individually or in concert to maximize the benefits while reducing undesirable effects and applying the lowest legal effective application rate, unless site-specific analysis determines a lower rate is needed to reduce non-target impacts. Treat only the minimum area necessary for effective control. Soil-activated herbicides can be applied as long as directions on the label are followed. NOAA RC will recommend project proponents seek the advice of a PCA if they are unfamiliar with the best chemical choices and combinations for their project, even if they are only planning to use the choices put forward in this biological assessment. If the project proponent is experienced with the use of certain chemicals and chemical mixtures, this extra step may not be necessary.
- To limit the opportunity for surface water contamination with herbicide use, all projects will have a minimum buffer for ground-based broadcast application of 100 feet, and the minimum buffer with a backpack sprayer is 15 feet (aerial application is not included in the proposed action).
- The licensed Applicator will follow recommendations for all California restrictions, including wind speed, rainfall, temperature inversion, and ground moisture for each herbicide used. In addition, herbicides will not be applied when rain is forecast to occur within 24 hours, or during a rain event or other adverse weather conditions (e.g., snow, fog).

- Herbicide adjuvants are limited to water or nontoxic or practically nontoxic vegetable oils and agriculturally registered, food grade colorants (e.g. Dynamark U.V. (red or blue), Aquamark blue or Hi-Light blue) to be used to detect drift or other unintended exposure to waterways. .
- Any herbicides will be transported to and from the worksite in tightly sealed waterproof carrying containers. The licensed Applicator will carry a spill cleanup kit. Should a spill occur, people will be kept away from affected areas until clean-up is complete. Herbicides will be mixed more than 150 feet, as practicable, from any water of the state to minimize the risk of an accidental discharge. Impervious material will be placed beneath mixing areas in such a manner as to contain any spills associated with mixing/refilling.
- The licensed pesticide applicator will keep a record of all plants/areas treated, amounts and types of herbicide used, and dates of application, and pesticide application reports must be completed within 24 hours of application and submitted to applicable agencies for review. Wind and other weather data will be monitored and reported for all pesticide application reports.

ACTIVE INGREDIENT	RISK QUOTIENT	LEVEL OF CONCERN
2,4-D (amine)	34.6	Low
Aminopyralid	417	Low
Chlorsulfuron	240	Low
Clethodim	6.43	Moderate
Clopyralid	47.3	Low
Dicamba	3.3	Moderate
Glyphosate1 (aquatic)	214	Low
Glophosate 2	7.9	Moderate
Imazapic	714	Low
Imazapyr	110	Low
Metsulfuron	163	Low
Picloram	3.5	Moderate
Sethoxydim	3.5	Moderate
Sulfometuron	321.7	Low
Triclopyr (TEA)	75.5	Low

Table 1 - The risk quotient (RQ) and level of concern for herbicides proposed for use in riparian areas of restoration projects. A low level of concern is for active ingredients with a RQ greater than 10. A moderate level of concern is for active ingredients with a RQ between 1 and 10 (Taken from BPA/NMFS 2020 and based on modeling done in support of that program development which also includes the use of herbicides as part of an integrated restoration program.

List of proposed herbicides for this Program
Below is a description of the known toxicity of herbicides proposed for use under this programmatic.

2,4-D amine. 2,4-D amine acts as a growth-regulating hormone on broad-leaf plants, being absorbed by leaves, stems and roots, and accumulating in a plant's growing tips. If an applicant uses 2,4 D amine, this action requires a 15-feet buffer when hand applied, and a 50-foot buffer when it is applied using a backpack sprayer.

Aminopyralid. This is a relatively new selective herbicide first registered for use in 2005. It is used to control broadleaf weeds, and is from the same family of herbicides as clopyralid, picloram and triclpyr. We propose to use aminopyralid for the selective control of broadleaf weeds. Acute toxicity tests show aminopyralid to be practically non-toxic, with aquatic invertebrates showing more sensitivity. Thus, if aminopyralid does end up in surface waters, the most likely pathway of effect for salmon and steelhead is through loss of prey.

Chlorsulfuron. This herbicide is used to control broadleaf weeds and some annual grasses. Chlorsulfuron is readily absorbed from the soil by plants. This herbicide does not bioaccumulate in fish. The buffers and application methods greatly minimize the risk of exposure to listed fish and their prey species.

Clethodim. Clethodim is a post emergence herbicide for control of annual and perennial grasses, and is applied as a ground broadcast spray or as a spot or localized spray. This Program is not allowing it for broadcast application; it is allowed for hand application and backpack sprayer, both with a 50-foot buffer.

Clopyralid. Clopyralid is a relatively new and very selective herbicide. It is toxic to some members of only three plant families. It is very effective against knapweeds, hawkweeds and Canada thistle. Clopyralid does not bind tightly to soil, and thus would seem to have a high potential for leaching. That potential is functionally reduced by the relatively rapid degradation of clopyralid in soil. It is one of the few herbicides that this Program proposes to allow up to the waterline (for hand application), but requires a 100-foot buffer for broadcast application. This Program only allows for one treatment per year.

Dicamba. This Program proposes to use dicamba to control broadleaf weeds, brush and vines. This programmatic shall not allow any broadcast application of Dicamba (because of issues associated with drift) for any project. Leaves and roots absorb dicamba and it moves through the plant. It should be applied during active plant growth periods, with spot and basal bark periodic application during dormancy. It does not bind to soil particles, and microbes appear to be the primary source of chemical breakdown in soil.

Glyphosate 1 (aquatic). Glyphosate is a nonselective herbicide used to control grasses and herbaceous plants; it is the most commonly used herbicide in the world. It is moderately persistent in soil, with an estimated average half-life of 47 days (range 1-174 days). Glyphosate is relatively non-toxic for fish. There is a low potential for the compound to build up in the tissues of aquatic invertebrates. The buffers and application methods greatly minimize the risk of exposure to listed fish and their prey species.

Imazapic. Imazapic is used to control grasses, broadleaves, vines, and for turf height suppression in non-cropland areas. The Program proposes to use imazapic in noxious weed control and rights-of-way management. The Program proposes to allow its use up to the waterline with hand injection methods, and 15-foot buffers for backpack sprayer application, and 100-foot buffers for broadcast application.

Imazapyr. Imazapyr is used to control a variety of grasses, broadleaf weeds, vines and brush species. The buffers and application methods greatly minimize the risk of exposure to listed fish and their prey species.

Metsulfuron methyl. The Program proposes to use the Escort formulation. It is used to control brush and certain woody plants, broadleaf weeds and annual grasses. It is active in soil and is absorbed from the soil by plants. At proposed application rates and conservation measures, it is unlikely to cause sublethal effects in any exposed salmonids.

Picloram. This is a restricted-use pesticide labeled for non-cropland forestry, rangeland, right-of-way, and roadside weed control. It is a growth inhibitor and is used to control a variety of broadleaf weed species. It is absorbed through the leaves and roots, and accumulates in new growth. The use of this herbicide is restricted to hand applications only (no broadcast applications) with a 25+ foot buffer and no use on sandy or riverwash soils. The buffers and application methods greatly minimize the risk of exposure to listed fish and their prey species.

Sethoxydim. This herbicide is a selective post-emergence pesticide for control of annual and perennial grasses. Its mode of action is lipid biosynthesis inhibition. Project design criteria and conservation measures sharply reduce the risk of exposure. The Program imposes a 50 foot no-application buffer for both spot spraying and hand application, and a 100-foot buffer for broadcast application. Other measures for wind speed, weather, etc., also reduce the risk of exposure. Thus the risk of acute or chronic exposure to sethoxydim is low.

Sulfometuron-methyl. At proposed application rates, sulfometuron methyl is highly toxic to seedlings of several broadleaves and grasses. The Program expects that no chronic exposure would occur because the herbicide degrades relatively rapidly. Based on the proposed conservation measures, the risk of exposure to concentrations that result in acute lethal effects or chronic effects is low.

Triclopyr (TEA). The environmental fate of triclopyr has been studied extensively. This formulation of triclopyr is not highly mobile, although soil adsorption decreases with decreasing organic matter and increasing pH. With the exception of aquatic plants, substantial risks to non-target species (including humans) associated with the contamination of surface water are low, relative to risks associated with contaminated vegetation. The buffers and application methods greatly minimize the risk of exposure to listed fish and their prey species.

Variance Process

Requests for variance from those limitations previously described in the proposed action will be considered. One potential example of a variance request would be allowing more than 1000 contiguous feet of stream to be dewatered if the water quality conditions were demonstrated to be poor (temperatures above 25 C) throughout the reach and no cold water refugia areas were identified in the area to be dewatered. Another example is a request to forego relocating fish prior to dewatering a stream reach with water temperatures greater than 25 C. The following process will be used to determine whether the proposed variance would result in effects of a nature or magnitude that were not analyzed during consultation. If so, the variance will not be granted. Variance requests may be submitted by project applicants at any time. Variance requests will be evaluated by NOAA RC and the Corps in coordination with WCR CCO. NOAA RC will receive and forward variance requests to WCR CCO. WCR CCO will assist NOAA RC and the Corps in determining whether or not the variance will be granted. NOAA RC will then notify the project applicants of whether or not the variance has been approved under the Program, and document the resolution of each variance request in their annual report for the Program. This documentation will include the following information:

1. A description of the project and the design feature within the project that needs a variance
2. The reason why the design feature requires a variance.
3. The specific design variance requested.
4. The rationale for why the requested variance will not result in effects that go beyond those analyzed during the ESA consultation on the Program, either in type or magnitude. In the temperature example, this rationale may include describing known temperature tolerances for species that may be present and any evidence that no salmonids have been detected in areas like this (e.g., the mainstem Eel River) above 25 C, to argue that no fish would be harmed by the requested variance.
5. Whether the design variance was granted or denied, and the rationale for any denials.

III. STATUS OF THE SPECIES AND CRITICAL HABITAT

Range-wide Status of the Species and Critical Habitat

This PBA examines the status of each species that would be adversely affected by the proposed action. The PBA also examines the condition of critical habitat throughout the designated area. This biological assessment analyzes the effects of the proposed action on the following listed species and their designated critical habitats:

Threatened Southern Oregon/Northern California coho salmon (*Oncorhynchus kisutch*)

- Listing determination (70 FR 37160; June 28, 2005)
- Critical habitat designation (64 FR 24049; May 5, 1999)

Threatened California Coastal (CC) Chinook salmon (*O. tshawytscha*)

- Listing determination (70 FR 37160; June 28, 2005)
- Critical habitat designation (70 FR 52488; September 2, 2005)

Threatened Northern California (NC) steelhead (*O. mykiss*)

- Listing determination (71 FR 834; January 5, 2006)
- Critical habitat designation (70 FR 52488; September 2, 2005)

Threatened Southern DPS Green Sturgeon (*Acipenser medirostris*)
- Listing Determination (71 FR 17757).
- Critical habitat designation

Threatened Southern DPS Eulachon (*Thaleichthys pacificus*)
- Listing Determination (Threatened 03/18/2010 75 FR 13012).
- Critical habitat designation (10/20/2011 76 FR 65324).

Species Description and Life History

<u>Coho Salmon</u>

The life history of coho salmon in California has been well documented by Shapovalov and Taft (1954) and Hassler (1987). In contrast to the life history patterns of other anadromous salmonids, coho salmon in California generally exhibit a relatively simple three year life cycle. Adult coho salmon typically begin the freshwater migration from the ocean to their natal streams after heavy late fall or winter rains breach the sandbars at the mouths of coastal streams (Sandercock 1991). Delays in river entry of over a month are not unusual (Salo and Bayliff 1958, Eames *et al.* 1981). Migration continues into March, generally peaking in December and January, with spawning occurring shortly after arrival to the spawning ground (Shapovalov and Taft 1954).

Coho salmon are typically associated with medium to small coastal streams characterized by heavily forested watersheds; perennially-flowing reaches of cool, high-quality water; dense riparian canopy; deep pools with abundant overhead cover; instream cover consisting of large, stable woody debris and undercut banks; and gravel or cobble substrates.

Female coho salmon choose spawning areas usually near the head of a riffle, just below a pool, where water changes from a laminar to a turbulent flow and small to medium gravel substrate are present. The flow characteristics surrounding the redd usually ensure good aeration of eggs and embryos, and flushing of waste products. The water circulation in these areas also facilitates fry emergence from the gravel. Preferred spawning grounds have: nearby overhead and submerged cover for holding adults; water depth of 4 to 21 inches; water velocities of 8 to 30 inches per second; clean, loosely compacted gravel (0.5 to 5 inch diameter) with less than 20 percent fine silt or sand content; cool water ranging from 39 to 50 degrees Fahrenheit (°F) with high dissolved oxygen of 8 mg/L; and inter-gravel flow sufficient to aerate the eggs. Lack of suitable gravel often limits successful spawning.

Each female builds a series of redds, moving upstream as she does so, and deposits a few hundred eggs in each. Fecundity of female coho salmon is directly proportional to size; each adult female coho salmon may deposit from 1,000 to 7,600 eggs (Sandercock 1991). Briggs (1953) noted a dominant male accompanies a female during spawning, but one or more subordinate males may also engage in spawning. Coho salmon may spawn in more than one redd and with more than one partner (Sandercock 1991). Coho salmon are semelparous meaning they die after spawning. The female may guard a redd for up to two weeks (Briggs 1953).

The eggs generally hatch after four to eight weeks, depending on water temperature. Survival and development rates depend on temperature and dissolved oxygen levels within the redd. According to Baker and Reynolds (1986), under optimum conditions, mortality during this period can be as low as 10 percent; under adverse conditions of high scouring flows or heavy siltation, mortality may be close to 100 percent. McMahon (1983) found that egg and fry survival drops sharply when fine sediment makes up 15 percent or more of the substrate. The newly-hatched fry remain in the redd from two to seven weeks before emerging from the gravel (Shapovalov and Taft 1954). Upon emergence, fry seek out shallow water, usually along stream margins. As they grow, juvenile coho salmon often occupy habitat at the heads of pools, which generally provide an optimum mix of high food availability and good cover with low swimming cost (Nielsen 1992). Chapman and Bjornn (1969) determined that larger parr tend to occupy the head of pools, with smaller parr found further down the pools. As the fish continue to grow, they move into deeper water and expand their territories until, by July and August; they reside exclusively in deep pool habitat. Juvenile coho salmon prefer: well shaded pools at least 3.3 feet deep with dense overhead cover, abundant submerged cover (undercut banks, logs, roots, and other woody debris); water temperatures of 54° to 59° F (Brett 1952, Reiser and Bjornn 1979), but not exceeding 73° to 77° F (Brungs and Jones 1977) for extended time periods; dissolved oxygen levels of 4 to 9 mg/L; and water velocities of 3.5 to 9.5 inches per second in pools and 12 to 18 inches per second in riffles. Water temperatures for good survival and growth of juvenile coho salmon range from 50° to 59° F (Bell 1973, McMahon 1983). Growth is slowed considerably at 64° F and ceases at 68° F (Bell 1973).

Preferred rearing habitat has little or no turbidity and high-sustained invertebrate forage production. Juvenile coho salmon feed primarily on drifting terrestrial insects, much of which are produced in the riparian canopy, and on aquatic invertebrates growing within the interstices of the substrate and in leaf litter in pools. As water temperatures decrease in the fall and winter months, fish stop or reduce feeding due to lack of food or in response to the colder water, and growth rates slow. During December through February, winter rains result in increased stream flows. By March, following peak flows, fish resume feeding on insects and crustaceans, and grow rapidly.

In the spring, as yearlings, juvenile coho salmon undergo a physiological process, or smoltification, which prepares them for living in the marine environment. They begin to migrate downstream to the ocean during late March and early April, and out-migration usually peaks in mid-May, if conditions are favorable. Emigration timing is correlated with peak upwelling currents along the coast. Entry into the ocean at this time facilitates more growth and, therefore, greater marine survival (Holtby *et al.* 1990). At this point, the smolts are about four to five inches in length. After entering the ocean, the immature salmon initially remain in nearshore waters close to their parent stream. They gradually move northward, staying over the continental shelf (Brown *et al.* 1994). Although they can range widely in the north Pacific, movements of coho salmon from California are poorly understood.

Chinook salmon

Chinook salmon return to freshwater to spawn when they are three to eight years old (Healey 1991). Some Chinook salmon return from the ocean to spawn one or more years before they reach full adult size, and are referred to as jacks (males) and jills (females). Chinook salmon runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and actual time of spawning (Myers *et al.* 1998). Both winter-run and spring-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months. For comparison, fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991).

Fall-run CC Chinook salmon migrate upstream from September through November, with most migration occurring in September and October following early-season rain storms. Spawning largely occurs from early October through December, with a peak in late October. Adequate instream flows and cool water temperatures are more critical for the survival of spring-run Chinook salmon (compared to fall-run or winter-run Chinook salmon) due to over-summering by adults and/or juveniles. Chinook salmon generally spawn in gravel beds that are located at the tails of holding pools (Bjornn and Reiser 1991). Adult female Chinook salmon prepare redds in stream areas with suitable gravel composition, water depth, and velocity. Optimal spawning temperatures range between 42° to 57° F. Redds vary widely in size and location within the river. Preferred spawning substrate is clean, loose gravel, mostly sized between 1 and 10 cm, with no more than 5 percent fine sediment. Gravels are unsuitable when they have been cemented with clay or fine particles or when sediments settle out onto redds, reducing inter-gravel percolation (62 FR 24588). Minimum inter-gravel percolation rate depends on flow rate, water depth, and water quality. The percolation rate must be adequate to maintain oxygen delivery to the eggs and remove metabolic wastes. Chinook salmon require a strong, constant level of subsurface flow, as a result, suitable spawning habitat is more limited in most rivers than superficial observation would suggest. After depositing eggs in redds, most adult Chinook salmon guard the redd from 4 to 25 days before dying.

Chinook salmon eggs incubate for 90 to 150 days, depending on water temperature. Successful incubation depends on several factors including dissolved oxygen levels, temperature, substrate size, amount of fine sediment, and water velocity. Maximum survival of incubating eggs and pre-emergent fry occurs at water temperatures between 42° and 56° F with a preferred temperature of 52° F. CC Chinook salmon fry emerge from redds during December through mid-April (Leidy and Leidy 1984).

After emergence, Chinook salmon fry seek out areas behind fallen trees, back eddies, undercut banks, and other areas of bank cover (Everest and Chapman 1972). As they grow larger, their habitat preferences change. Juveniles move away from stream margins and begin to use deeper water areas with slightly faster water velocities, but continue to use available cover to minimize predation risk and reduce energy expenditure. Fish size appears to be positively correlated with water velocity and depth (Chapman and Bjornn 1969, Everest and Chapman 1972). Optimal temperatures for both Chinook salmon fry and fingerlings range from 54° to 57° F, with maximum growth rates at 55° F (Boles 1988). Chinook salmon feed on small terrestrial and aquatic insects and aquatic crustaceans. Cover, in the form of rocks, submerged aquatic vegetation, logs, riparian vegetation, and undercut banks provide food, shade, and protect juveniles from predation. CC Chinook salmon will rear in freshwater for a few months and outmigrate during April through July (Myers *et al.* 1998).

<u>Steelhead</u>

Steelhead are anadromous forms of *O. mykiss*, spending some time in both freshwater and saltwater. Steelhead young usually rear in freshwater for one to three years before migrating to the ocean as smolts, but rearing periods of up to seven years have been reported. Migration to the ocean usually occurs in the spring. Steelhead may remain in the ocean for one to five years (two to three years is most common) before returning to their natal streams to spawn (Busby *et al.* 1996). The distribution of steelhead in the ocean is not well known. Coded wire tag recoveries indicate that most steelhead tend to migrate north and south along the continental shelf (Barnhart 1986).

Steelhead can be divided into two reproductive ecotypes, based upon their state of sexual maturity at the time of river entry and the duration of their spawning migration: stream maturing and ocean maturing. Stream maturing steelhead enter fresh water in a sexually immature condition and require several months to mature and spawn, whereas ocean maturing steelhead enter fresh water with well-developed gonads and spawn shortly after river entry. These two reproductive ecotypes are more commonly referred to by their season of freshwater entry (*i.e.,* summer [stream maturing] and winter [ocean maturing] steelhead). The timing of upstream migration of winter steelhead, the ecotype most likely encountered during the proposed action, is typically correlated with higher flow events occurring from late October through May. In central and southern California, significant river outflow is also often required to breach sandbars that block access from the ocean; for this reason, upstream steelhead migration in these areas can be significantly delayed, or precluded entirely during extremely dry periods. Adult summer steelhead migrate upstream from March through September; however, results from past capture/relocation efforts in the action area (CDFW 2014, 2015, 2016, 2017, 2018, 2019) suggest the chance of encountering adult summer steelhead during the Program's "work window" is extremely low and thus unlikely to occur. In contrast to other species of *Oncorhynchus*, steelhead may spawn more than one season before dying (iteroparity); although one-time spawners represent the majority.

Because rearing juvenile steelhead reside in freshwater all year, adequate flow and temperature are important to the population at all times [California Department of Fish and Game (CDFG) 1997]. Outmigration appears to be more closely associated with size than age. In Waddell Creek, Shapovalov and Taft (1954) found steelhead juveniles migrating downstream at all times of the year, with the largest numbers of young-of-year and age 1+ steelhead moving downstream during spring and summer. Smolts can range from 5.5 to 8 inches in length. Steelhead outmigration timing is similar to coho salmon (NMFS 2016).

Survival to emergence of steelhead embryos is inversely related to the proportion of fine sediment in the spawning gravels. However, steelhead are slightly more tolerant than other salmonids, with significantly reduced survival when fine materials of less than 0.25 inches in diameter comprise 20 to 25 percent of the substrate. Fry typically emerge from the gravel two to three weeks after hatching (Barnhart 1986).

Upon emerging from the gravel, fry rear in edge-water habitats and move gradually into pools and riffles as they grow larger. Older fry establish territories which they defend. Cover is an important habitat component for juvenile steelhead, both as a velocity refuge and as a means of avoiding predation (Meehan and Bjornn 1991). Steelhead, however, tend to use riffles and other habitats not strongly associated with cover during summer rearing more than other salmonids. Young steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. In winter, juvenile steelhead become less active and hide in available cover, including gravel or woody debris.

Water temperature can influence the metabolic rate, distribution, abundance, and swimming ability of rearing juvenile steelhead (Barnhart 1986, Bjornn and Reiser 1991, Myrick and Cech 2005). Optimal temperatures for steelhead growth range between 50° and 68° F (Hokanson *et al.* 1977, Wurtsbaugh and Davis 1977, Myrick and Cech 2005). Variability in the diurnal water temperature range is also important for the survivability and growth of salmonids (Busby *et al.* 1996).

Suspended sediment concentrations, or turbidity, also can influence the distribution and growth of steelhead (Bell 1973, Sigler *et al.* 1984, Newcombe and Jensen 1996). Bell (1973) found suspended sediment loads of less than 25 milligrams per liter (mg/L) were typically suitable for rearing juvenile steelhead.

<u>Green Sturgeon</u>

The southern distinct population segment (DPS) of green sturgeon was listed as threatened in 2006 (71 FR 17757). The green sturgeon is a long-lived, slow-growing fish species. Mature males range from 4.5 to 6.5 feet in fork length and they do not mature until they are at least 15 years old, whereas mature females range from 5 to 7 feet in fork length and do not mature until they are at least 17 years old (Kelly et al. 2007). The maximum ages of adult green sturgeon are likely to range from 60 to 70 years. The southern DPS green sturgeon generally occur from Graves Harbor, Alaska to Monterey, California (Moser and Lindley 2007).

Moser and Lindley (2007) indicated that green sturgeon may use coastal bays as foraging habitat due to their high productivity. Based on acoustic tagging data conducted in 2007 and 2008 (USFWS unpublished data), green sturgeon move in channels, as would be expected for larger fish. However, 97% of observations occurred at two detection locations: Arcata Channel and Main Channel near the Samoa Bridge in Humboldt Bay (USFWS unpublished data). Relatively few observations occurred in the Mad River Channel. A follow-up survey of sturgeon use of Humboldt Bay by NMFS and USFWS (Goldsworthy et al. 2016) indicated that the sturgeon primarily used the Arcata Channel and were observed feeding on northern anchovy (Engraulis mordax) approximately 3.2 to 6.6 feet below the water's surface in the channel. Fish were observed in Mad River Slough, near the project site using the channel. Finally, the fish were observed in the intertidal zone for short forays, potentially following anchovies into shallower habitat. These fish were originally tagged in the Sacramento River in 2011, and are considered part of the Southern Distinct Population Segment.

Eulachon

Eulachon are smelt native to eastern North Pacific waters from the Bering Sea to Monterey Bay, California, or from 61º N to 31º N (Hart and McHugh 1944; Odemar 1964; Hay and McCarter 2000). Adult eulachon are found in coastal and offshore marine habitats possibly to 2,000 feet deep, but more frequently between 50 and 600 feet deep (Allen and Smith 1988; Hay and McCarter 2000; Willson et al. 2006). The southern DPS eulachon comprises eulachon originating from the Skeena River in British Columbia south to and including the Mad River in northern California (Figure 12)(50 CFR 223.102(e)). However, eulachon may have historically occurred in the Sacramento River system and even farther south along the California and Baja California coast, in areas where they may have been extirpated (Willson et al. 2006).

For southern DPS eulachon, most spawning is believed to occur in the Columbia River and its tributaries (Grays, Skamokawa, Elochoman, Kalama, Lewis, and Sandy rivers), with less production from the Mad and Klamath rivers, as well as sporadic production in other Oregon and Washington rivers (Emmett et al. 1991; Musick et al. 2000; WDFW and ODFW 2001).

We do not anticipate eulachon will be present during our restoration project implementation due to the proposed work windows (June 15 - November 1) not coinciding with when adult and juvenile eulachon will be in the action area (winter - spring) and we don't expect eulachon will be encountered in the Klamath and Mad rivers and in estuarine areas while performing effectiveness monitoring.

Status of Species

SONCC coho salmon

Although long-term data on coho salmon abundance are scarce, the available evidence from short-term research and monitoring efforts indicate that spawner abundance has declined since the last status review for populations in this ESU (Williams *et al.* 2016). In fact, most of the 30 independent populations in the ESU are at high risk of extinction because they are below or likely below their depensation threshold, which can be thought of as the minimum number of adults needed for survival of a population.

The distribution of SONCC coho salmon within the ESU is reduced and fragmented, as evidenced by an increasing number of previously occupied streams from which SONCC coho salmon are now absent (Good *et al.* 2005, Williams *et al.* 2011, and Williams *et al.* 2016). Extant populations can still be found in all major river basins within the ESU (70 FR 37160). However, extirpations, loss of brood years, and sharp declines in abundance (in some cases to zero) of SONCC coho salmon in several streams throughout the ESU indicate that the SONCC coho salmon's spatial structure is more fragmented at the population-level than at the ESU scale. The genetic and life history diversity of populations of SONCC coho salmon is likely very low and is inadequate to contribute to a viable ESU, given the significant reductions in abundance and distribution.

NC Steelhead

With few exceptions, NC steelhead are present wherever streams are accessible to anadromous fish and have sufficient flows. The most recent status review by Williams *et al.* (2016) reports that available information for winter-run and summer-run populations of NC steelhead do not suggest an appreciable increase or decrease in extinction risk since publication of the previous status review update in 2011 (Williams *et al.* 2011). Williams *et al.* (2016) found that population abundance was very low relative to historical estimates, and recent trends are downwards in most stocks.

NC steelhead remain broadly distributed throughout their range, with the exception of habitat upstream of dams on both the Mad River and Eel River, which has reduced the extent of available habitat. Extant summer-run steelhead populations exist in Redwood Creek and the Mad, Eel (Middle Fork) and Mattole Rivers. The abundance of summer-run steelhead was considered "very low" in 1996 (Good *et al.* 2005), indicating that an important component of life history diversity in this DPS is at risk. Hatchery practices in this DPS have exposed the wild population to genetic introgression and the potential for deleterious interactions between native stock and introduced steelhead. However, abundance and productivity in this DPS are of most concern, relative to NC steelhead spatial structure and diversity (Williams *et al.* 2011). The most recent status review for NC steelhead (Seghesio and Wilson 2016) concludes NC steelhead, despite recent conservation efforts, remain impacted by many of the factors that led to the species being listing as threatened. Low streamflow volume, illegal cannabis cultivation, and periods of poor ocean productivity continue to depress NC steelhead population viability.

CC Chinook salmon

The CC Chinook salmon ESU was historically comprised of approximately 32 Chinook salmon populations (Bjorkstedt *et al.* 2005). Many of these populations (about 14) were independent, or potentially independent, meaning they had a high likelihood of surviving for 100 years absent anthropogenic impacts. The remaining populations were likely more dependent upon immigration from nearby independent populations than dependent populations of other salmonids (Bjorkstedt *et al.* 2005).

In 1965, CDFG (1965) estimated escapement for this ESU at over 76,000 spawning adults. Most were in the Eel River (55,500), with smaller populations in Redwood Creek (5,000), Mad River (5,000), Mattole River (5,000), Russian River (500) and several smaller streams in Humboldt County (Myers *et al.* 1998). Currently available data indicate abundance is far lower, suggesting an inability to sustain production adequate to maintain the ESU's populations. The one exception is the Russian River population, where escapement typically averages a few thousand adults (Sonoma Water 2020).

CC Chinook salmon populations remain widely distributed throughout much of the ESU. Notable exceptions include the area between the Navarro River and Russian River and the area between the Mattole and Ten Mile River populations (Lost Coast area).Concerns regarding the lack of population-level estimates of abundance, the loss of populations from one diversity stratum[1], as well poor ocean survival contributed to the conclusion that CC Chinook salmon are "likely to become endangered" in the foreseeable future (Good *et al.* 2005, Williams *et al.* 2011, Williams *et al.* 2016). Yet, some encouraging news from the NMFS 2016 CC Chinook status review is the recent discovery of spawning adults in several smaller, coastal Mendocino County tributaries, which suggests ESU spatial diversity is likely better than previously thought (Seghesio and Wilson 2016).

Green Sturgeon

According to NMFS (2018), the only confirmed spawning populations of the southern DPS of green sturgeon is the Sacramento River Basin. Adults and sub-adults spend most of their life history in the nearshore marine environment and coastal bays and estuaries along the West Coast. Habitat loss, habitat degradation, and limited spawning areas are the most common threats to green sturgeon. Fishing pressure may also affect the population because their documented long distance migrations may subject them to fishing seasons in multiple locations (Moser and Lindley 2007). Limiting factors for green sturgeon include:

- Reduction of its spawning area to a single known population
- Lack of water quantity
- Poor water quality
- Poaching

Eulachon

In Oregon, NMFS designated 24.2 miles of the lower Umpqua River, 12.4 miles of the lower Sandy River, and 0.2 miles of Tenmile Creek. NMFS also designated the mainstem Columbia River from the mouth to the base of Bonneville Dam, a distance of 143.2 miles. Dams and water diversions are moderate threats to eulachon in the Columbia and Klamath rivers where hydropower generation and flood control are major activities. Degraded water quality is common in some areas occupied by southern DPS eulachon. In the Columbia and Klamath River basins, large-scale impoundment of water has increased winter water temperatures, potentially altering the water temperature during eulachon spawning periods. Numerous chemical contaminants are also present in spawning rivers, but the exact effect these compounds have on spawning and egg development is unknown. Dredging is a low to moderate threat to eulachon in the Columbia River. Dredging during eulachon spawning would be particularly detrimental. Limiting factors for eulachon include:

- Changes in ocean conditions due to climate change, particularly in the southern portion of the species' range where ocean warming trends may be the most pronounced and may alter prey, spawning, and rearing success.
- Climate-induced change to freshwater habitats
- Bycatch of eulachon in commercial fisheries
- Adverse effects related to dams and water diversions

[1] A diversity stratum is a grouping of populations that share similar genetic features and live in similar ecological conditions.

- Water quality
- Shoreline construction
- Over harvest
- Predation

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

Historically, the Klamath River was described as the southern limit of the range of eulachon (Hubbs 1925, Schultz and DeLacy 1935). Other accounts have described large spawning aggregations of eulachon occurring regularly in the Klamath River (Fry 1979, Moyle et al. 1995, Larson and Belchik 1998, Moyle 2002, Hamilton et al. 2005), occasionally in the Mad River (Moyle et al. 1995, Moyle 2002), and Redwood Creek (Ridenhour and Hofstra 1994, Moyle et al. 1995). In addition, small numbers of eulachon have been reported from the Smith River (Moyle 2002). The only reported commercial catch of eulachon in Northern California occurred in 1963 when a combined total of 25 metric tons (56,000 lbs.) was landed from the Klamath River, the Mad River, and Redwood Creek (Odemar 1964). Since 1963, the run size has declined to the point that only a few individual fish have been caught in recent years. Moyle (2002) indicates that eulachon have been scarce in the Klamath River since the 1970s, with the exception of three years: they were plentiful in 1988 and moderately abundant again in 1989 and 1998. After 1998, they were thought to be extinct in the Klamath Basin, until a small run was observed in the estuary in 2004. According to accounts of Yurok Tribal elders, the last noticeable runs of eulachon were observed in the Klamath River in 1988 and 1989 by Tribal fishers (Larson and Belchik 1998). However, in January 2007, six eulachon were reportedly caught by tribal fishers on the Klamath River. Larson and Belchik (1998) report that eulachon have not been commercially important in the Klamath River. With funding from NMFS, the Yurok Tribal fisheries biologists surveyed for eulachon in the Lower Klamath River and found only two eulachon (tribal fishermen caught another five) in early 2011 and 40 in 2012 (YTFP 2011, YTFP 2012). Reports from Yurok tribal fisheries biologists also report capturing adult eulachon in presence/absence surveys (seine/dip nets) in the Klamath River in 2013 (112 eulachon), and 2014 (1,000 eulachon).

Status of Critical Habitat

Salmonids

The condition of SONCC coho salmon; CC Chinook salmon; and NC steelhead critical habitat, specifically its ability to provide for their conservation, has been degraded from conditions known to support viable salmonid populations. NMFS has determined that currently depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat[2]: logging, agriculture, mining, urbanization, stream channelization, dams, wetland loss, and water withdrawals (including unscreened diversions for irrigation). Impacts of concern include altered stream bank and channel morphology, elevated water temperature, lost spawning and rearing habitat, habitat fragmentation, impaired gravel and wood recruitment from upstream sources, degraded water quality, lost riparian vegetation, and increased erosion into streams from upland areas (Weitkamp *et al.* 1995; Busby *et al.* 1996; 64 FR 24049; 70 FR 37160; 70 FR 52488). Diversion and storage of river and stream flow has dramatically altered the natural hydrologic cycle in many of the streams within the ESU. Altered flow regimes can delay or preclude migration, dewater aquatic habitat, and strand fish in disconnected pools, while unscreened diversions can entrain juvenile fish.

<u>Green Sturgeon</u>

Tracking studies in San Francisco Bay suggest that directional movement of sturgeon in shallow areas (between 6 feet to 10 feet) occurs for less than 30 minutes at a time (Kelly et al. 2007). It is notable that mudflats in Humboldt Bay are typically shallower than the study in San Francisco Bay. In addition, the Kelly et al. (2007) study indicated that green sturgeon that exhibit non directional movement, likely for foraging, are most common at depths ranging from 26.3 feet to 39.4 feet. The observations in Humboldt Bay suggest that the large number of detections (148,997) near the extreme north end of Arcata Channel, likely represents an area where feeding is occurring (USFWS unpublished data). We expect this restoration program only to have minimal effects to SDPS green sturgeon in Humboldt Bay through short term pulses of sediment derived from restoration projects in estuarine areas.

<u>Eulachon</u>

In the Klamath River, critical habitat is designated from the mouth of the Klamath River upstream to the confluence with Omogar Creek at approximately river mile (RM) 10.5. In the Klamath River basin, critical habitat does not include lands within the Yurok Indian Reservation, or the Resighini Rancheria located in the Lower Klamath River.
The action area includes all three physical or biological features that constitute critical habitat: (1) freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, (2) freshwater and estuarine migration corridors free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted, and (3) nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. All three habitat features do not appear to be limited in the Lower Klamath River and nearshore marine area.

In the absence of any consistent targeted surveys or fisheries for the Klamath River, very little is known about the presence or populations of Pacific eulachon in other watersheds within the

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[2]Other factors, such as over fishing and artificial propagation, have also contributed to the current population status of these species. All these human induced factors have exacerbated the adverse effects of natural environmental variability from such factors as drought and poor ocean conditions.

action area. The presence of suitable spawning habitat in the Lower Klamath River does not seem to be limited; therefore the strength of their runs may be strongly dependent on the influence of climate change and/or harvest.

There are currently no harvest regulations for eulachon in the Klamath River. However, eulachon abundance has declined so dramatically that there is little fishing effort for eulachon in the Klamath River. Limited eulachon fishing is conducted mostly by the Yurok Tribe in the Lower Klamath River.

Bartholow (2005) found that the Klamath River is increasing in water temperature by 0.5°C/decade, which may be related to warming trends in the region (Bartholow 2005) and/or alterations of the hydrologic regime resulting from the Reclamation's Klamath Project, logging, and water use in Klamath River tributary basins. Because spawning normally occurs when water temperature is between 39º and 50º F, water temperature increases in the Klamath River during the late winter/early spring may reduce eulachon spawning in the Lower Klamath River.

Critical habitat for eulachon includes portions of 16 rivers and streams in California, Oregon, and Washington. All of these areas are designated as migration and spawning habitat for this species.

IV. EFFECTS OF THE PROPOSED ACTION

This section describes the effects of restoration activities authorized under the Program on three listed salmonids, green sturgeon, and eulachon, as well as their critical habitats. The majority of our impacts, as described below, will be affecting juvenile salmonids and their critical habitat. We do not anticipate effects to eulachon in the Klamath and Mad rivers and in estuarine areas while implementing restoration projects and while performing effectiveness monitoring. In addition, we do anticipate, on rare occasions, minor effects to adult green sturgeon in the Humboldt Bay and other estuarine areas during summer estuary restoration projects through a minor increase in turbidity. The specific effects to salmonids, green sturgeon and eulachon are described in greater detail below.

Effects to Listed Salmon and Steelhead and their Critical Habitat

Fish Handling and Monitoring Activities

Description of effects and project types these effects may result from

All project sites that require dewatering will include fish relocation. A qualified biologist will capture and relocate fish (and amphibians) away from the restoration project work site to minimize adverse effects of dewatering to listed salmonids. Fish in the immediate project area will be captured by seine, dip net and/or by electrofishing, and will then be transported and released to a suitable instream location. In addition, pre and post project implementation effectiveness monitoring will be conducted at select sites. Where effectiveness monitoring will occur, fish will be sampled utilizing accepted techniques by snorkel survey, electrofishing, seine, minnow trapping, and dip net, and will then be processed (e.g., enumerated, weighed, measured, tagged) and released to a suitable location. Fish sampling will generally require wading by individuals operating the sampling gear and would possibly agitate the stream bottom substrate where the gear is deployed. Captured fish will be held in cool, oxygenated freshwater.

Relevant BMPs, program rules and design elements

In cases where portions of or the entire channel cross-section must be dewatered, fish will need to be relocated to areas outside of the project area. During effectiveness monitoring, protective measures will be needed to minimize harm to individuals. The protection measures listed in the Restoration Effectiveness Monitoring section will be implemented as applicable to minimize the potential for adverse effects to individuals during fish relocation and monitoring efforts.

Effects to species

Exposure

Because the region-specific in-water work windows are designed to avoid the non-migratory life stages, the species and life stages most likely to be exposed to fish relocation and effectiveness monitoring activities are juvenile salmonids. While migrating adult salmonids may be present, their mobility will allow them to avoid construction and monitoring areas. However, low numbers of juvenile salmonids may be present at or near project and monitoring sites.

Any fish collecting gear, whether passive or active (Hayes 1983) has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of injury and mortality attributable to fish capture varies widely depending on the method used, the ambient conditions, and the expertise and experience of the field crew. The effects of seining and dip-netting on juvenile salmonids include stress, scale loss, physical damage, suffocation, and desiccation. Electrofishing can kill juvenile salmonids, and researchers have found serious sub-lethal effects including spinal injuries (Reynolds 1983, Habera et al. 1996, Habera et al. 1999, Nielsen 1998, Nordwall 1999). The long-term effects of electrofishing on salmonids are not well understood. Although chronic effects may occur, most effects from electrofishing occur at the time of capture and handling.

Most of the stress and death from handling result from differences in water temperature between the stream and the temporary holding containers, dissolved oxygen levels, the amount of time that fish are held out of the water, and physical injury. Handling-related stress increases rapidly if water temperature exceeds 18°C or dissolved oxygen is below saturation.
Although sites selected for relocating fish will likely have similar water temperature as the capture site and should have ample habitat, in some instances relocated fish may endure short-term stress from crowding at the relocation sites. Relocated fish may also have to compete with other salmonids, which can increase competition for available resources such as food and habitat. Some of the fish at the relocation sites may choose not to remain in these areas.

Response

Fish relocation and monitoring activities may injure or kill juvenile salmonids that may be present at project or monitoring sites. Any fish collecting gear, whether passive or active, has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of injury and mortality attributable to fish capture varies widely depending on the method used, the ambient conditions, and the expertise and experience of the field crew. The effects of seining and dip-netting on juvenile salmonids include stress, scale loss, physical damage, suffocation, and desiccation. Electrofishing can kill juvenile salmonids, and researchers have found serious sublethal effects including spinal injuries. Although chronic effects may occur, most effects from electrofishing occur at the time of capture and handling. The long-term effects of electrofishing on salmonids are not well understood.

Effects associated with fish relocation and monitoring activities will be significantly minimized due to the minimization measures that will be utilized, as described in the proposed action. It is expected that fish relocation and monitoring activities will not significantly reduce the number of returning listed salmonid adults. Data from two years (2002, 2003) of fish relocation activities in Humboldt County associated with habitat restoration projects authorized under the Corps' 1998 Regional General Permit for CDFW-funded restoration projects, indicate mortality rates associated with individual fish relocation sites are less than 3% and the mean mortality rates for all sites are less than 1% (Collins 2004). A NMFS (2012) review of all Fisheries Restoration Grant Program (FRGP) annual monitoring reports of dewatering and relocation activities found that the highest percentage of steelhead killed was 0.56% across 99 projects that had dewatering during years 2002-2010. If fish mortality greater than 3% of the catch of a listed species occurs during sampling, NMFS will be contacted and provided with fish rescue information and/or mortalities by species. Sampling or relocation will only be performed again with the approval of NMFS.

Most of the stress and death from handling result from differences in water temperature between the stream and the temporary holding containers, dissolved oxygen levels, the amount of time that fish are held out of the water, and physical injury. Handling-related stress increases rapidly if water temperature exceeds 18°C or dissolved oxygen is below saturation. A qualified biologist will relocate fish, following NMFS electrofishing guidelines. Because of these measures, direct effects to, and mortality of, juvenile salmonids during capture will be greatly minimized.

Although sites selected for relocating or releasing handled fish will likely have similar water temperature as the capture site and should have ample habitat, in some instances relocated fish may endure short-term stress from crowding at the relocation sites. Relocated fish may also have to compete with other salmonids, which can increase competition for available resources such as food and habitat. Some of the fish at the relocation sites may choose not to remain in these areas and may move either upstream or downstream to areas that have more habitat and lower fish densities. As each fish moves, competition remains either localized to a small area or quickly diminishes as fish disperse.

Effects to habitat

Effects to habitat from fish handling would be an indirect effect and would occur during project dewatering and monitoring activities.

Exposure

Exposure to effects from the subsequent dewatering, monitoring, removal and relocation of fish on habitat would be from turbidity created while qualified biologists are wading in the river capturing fish. The turbidity would likely be limited to the area being dewatered/monitored and would likely travel downstream for the duration of the capture event. Turbidity usually returns to baseline conditions within 15 minutes - 1 hour after the disturbance, depending on streamflow conditions, and effects would be short term.

Response

Critical habitat Physical and Biological Features (PBFs) of critical habitat for the listed species described above may be adversely impacted due to components of restoration activities. These PBFs include spawning, rearing, and migration habitats. The potential adverse effects to critical habitat are expected to follow the same effects pathways as the effects to species, primarily caused by dewatering, physical disturbance and increased mobilization of sediment. These effects may be caused by a number of different project types, but all are expected to be short-term.

Dewatering

Description of effects and project types these effects may result from

In stream reaches where listed salmonids are present during construction, efforts will be made to design construction activities to avoid complete dewatering of a channel cross-section in a manner that maintains fish passage through the construction area. Dewatering encompasses placing temporary barriers, such as a cofferdam, to isolate the work area, rerouting stream flow around the dewatered area, pumping water out of the isolated work area, relocating fish from the work area (discussed separately), and restoring the project site upon project completion. Any project types that may involve in-water work have the potential to require dewatering and so reduce available habitat for listed salmonids as well as degrade their habitat. Dewatering of a project reach may result from a variety project types as described above in the Project Description section, and include channel filling projects where existing aquatic habitat in incised channels is filled with sediment during grading activities.

Relevant BMPs, program rules, and design elements

In stream reaches where anadromous fish are present during construction, efforts will be made to design construction activities to avoid complete dewatering of a channel cross-section in a manner that maintains fish passage through the construction area. In cases where the entire channel cross-section must be dewatered, the protection measures listed above in the dewatering section will be implemented as applicable. Effects associated with dewatering activities are expected to be minimized due to the above described minimization measures.

Effects to species

Exposure

Because the region-specific in-water work windows are designed to avoid the non-migratory life stages, the species and life stages most likely to be exposed to potential effects of dewatering are juvenile salmonids. While migrating adult salmonids may be present, their mobility will allow them to avoid the construction areas. The number of juvenile salmonids that avoid capture and remain in the project work area is expected to be low due to 1. The avoidance behavior of juvenile slamonids to disturbance, 2. the small area affected during dewatering at each site, 3. the low number of juvenile salmonids in the typically-degraded habitat conditions common to proposed restoration sites, and 4. the effectiveness of capture methods.

Response

Juvenile salmonids that avoid capture in the project work area will likely die during dewatering activities. However, it is expected that the number of juveniles that will be killed as a result of barrier placement and stranding during site dewatering activities is very low, likely less than one percent of the total number of salmonids in the project area. The low number of juveniles expected to be injured or killed as a result of dewatering is based on the avoidance behavior of juveniles to disturbance, the small area affected during dewatering at each site, the low number of juveniles in the typically degraded habitat conditions common to proposed restoration sites, and the low numbers of juvenile salmonids expected to be present within each project site after relocation activities.

Stream flow diversion and project work area dewatering are expected to cause temporary loss, alteration, and reduction of aquatic habitat for juvenile salmonids. The extent of temporary loss of juvenile rearing habitat should be minimal because habitat at the restoration sites is typically degraded. These sites will be restored prior to project completion and will be enhanced by the restoration project. Fluctuations in flow outside of dewatered areas are anticipated to be small, gradual, and short-term, which should not result in any harm to salmonids.

Benthic (i.e., bottom dwelling) aquatic macroinvertebrate populations may be temporarily lost or their abundance reduced when creek habitat is dewatered (Cushman 1985). Effects to aquatic macroinvertebrates resulting from stream flow diversions and dewatering will be temporary because construction activities will be relatively short-lived, and rapid recolonization (about one to two months) of disturbed areas by macroinvertebrates (Cushman 1985; Attrill and Thomas 1996; Harvey 1986) is expected following the return of flow to the dewatered area. In addition, the effect of macroinvertebrate loss on salmonids is likely to be negligible because food from upstream sources (via drift) would be available downstream of the dewatered areas since stream flows will be maintained around the project work site.

In consideration of the proposed in-water work windows, dewatering activities are expected to result in a reduction in the survival probability of juvenile salmonids that avoid capture in the project work area. It is expected that the number of juvenile salmonids that may be killed as a result of barrier placement and stranding during site dewatering activities is very low, and likely less than one percent of the total number of salmonids in the project footprint. Because of their relative mobility, returning or holding adult salmonids present within the project vicinity are not expected to be affected by dewatering activities. Juvenile salmonids that are successfully captured will be temporarily moved to the best available habitat nearby. If this habitat is inferior to their original habitat, they may grow less well and their survival may be reduced within that season or later on if they don't reach the size needed to succeed in the ocean environment.

Effects to habitat

Exposure

Dewatering and filling of the stream channel will result in a temporary loss of function and short term impacts to aquatic organisms within the stream channel and adjacent riparian areas. These effects will last for the duration of the dewatering event or in the event of channel filling projects, and last as long as it takes for a new channel to form and capture flow.

Response

Critical habitat Physical and Biological Features (PBFs) of critical habitat for the listed species described above may be adversely impacted due to components of restoration activities. These PBFs include spawning, rearing, and migration habitats. The potential adverse effects to critical habitat are expected to follow the same effects pathways as the effects to species, primarily caused by dewatering, physical disturbance and increased mobilization of sediment. These effects may be caused by a number of different project types, but all are expected to be short-term.

Existing benthic (i.e., bottom dwelling) aquatic macroinvertebrate populations in streams are expected to die when their habitat is dewatered, reducing the food available to juvenile fishes. Such a reduction in food resources would be temporary (maximum time of four months), and rapid recolonization (about one to two months) of disturbed areas by macroinvertebrates is expected following the return of flow to the dewatered area, providing that nearby macroinvertebrate populations have persisted. In addition, the effect of macroinvertebrate loss is likely to be small because 1. the size of the dewatered area is limited and 2. food delivery from upstream sources (via drift) would immediately resume once the stream flow is restored.

Instream habitat structures and improvement projects will provide escape from predators and resting cover, increase spawning habitat, improve upstream and downstream migration corridors, improve pool to riffle ratios, and add habitat complexity and diversity. Some structures will be designed to reduce sedimentation, protect unstable banks, stabilize existing slides, provide shade, and create scour pools. Instream habitat structures such as woody material and boulders contribute to habitat diversity and create and maintain foraging, cover, and resting habitat for both adult and juvenile anadromous fish. Placement of instream woody material on the banks of the active channel will create instantly available habitat by creating diverse cover for juvenile rearing. Activities described in the proposed action will improve the quality of spawning habitat over the long term. Salmonid spawning habitat will be improved by reducing the amount of sediment that enters the stream in the long term through various types of erosion control. Additionally, gravel augmentation, described in the proposed action, will increase the amount of spawning habitat available

Physical Disturbance

Description of effects and project types these effects may result from

Most of the proposed restoration project types include the potential for physical disturbance of aquatic habitat through placement of habitat structures and gravel, excavation and reconfiguration of stream channel substrate, removal or replacement of existing infrastructure and development of temporary access to the project site. These structural placements and channel manipulations can vary in their size and extent, depending on their restoration objective. Most habitat structure and gravel augmentation placements are discrete, where only a localized area is expected to be affected, thus, for these project types, dewatering may not occur. Physical disturbance associated with floodplain and off channel habitat restoration, barrier manipulation and channel reconfiguration actions can affect a larger area of the stream and effects can extend beyond the disturbed area. For these project types where the effects are not localized, project activities will include dewatering.

Relevant BMPs, program rules, and design elements

In stream reaches where anadromous fish are present during construction, efforts will be made to design construction activities to minimize physical disturbance of existing habitat. In cases where habitat will be disturbed or eliminated, the protection measures listed above in relevant project types will be implemented as applicable. Effects associated with physical disturbance are expected to be minimized due to the above described minimization measures.

Effects to species

Exposure

Physical disturbance of aquatic habitat may occur during construction activities and the removal or placement of materials, which has the potential to affect the juvenile and adult life stages of salmonids through direct injury or displacement and disruption of normal behaviors.

Physical disturbance when habitat will not be dewatered

Projects involving habitat structure placement, gravel augmentation and creation of temporary project access may occur in reaches that have not been dewatered. Materials added to the riverbed and equipment working in the river could injure or kill juvenile salmonids. However, the number of juveniles injured or killed is expected to be no more than the number of individuals that will be killed by desiccation after the reach is dewatered without such structural placement.

The majority of gravel augmentation and temporary access development activities will occur within shallow areas in the middle of the channel, where fewer juveniles are expected to be rearing, given their preference for the channel margins. Studies indicate that juvenile salmonids tend to be found within 10-20 feet of riverbanks. Therefore, a low number of juveniles are expected to be injured or killed because of physical disturbance based on the avoidance behavior of juveniles to disturbance, the small area affected during construction activities at each site, and limited number of juveniles present due to lack of suitable habitat in the construction areas.

Occasionally, feeding juvenile salmonids may be attracted to activity stirring up sediment, but whenever they detect an immediate threat, they are expected to quickly move away. Also, the area disturbed by placement of materials or temporary access of equipment and their associated turbidity at any given time is expected to be only a portion of the river width; therefore, juveniles will have opportunities to move to other portions of the channel where they can avoid potential injury or death. Adult salmonids are expected to move out of the area to adjacent suitable habitat before equipment enters the water or before gravel, logs, or boulders are placed over them. Therefore, a potential impact to adult salmonids from construction is considered extremely unlikely to occur.

Physical disturbance when habitat will be dewatered

All other physical disturbance, such as excavation and reconfiguration of stream channels, off channel areas and floodplains and barrier modification will only occur in areas that have been dewatered.

Direct injury or death may occur during instream construction activities associated with many of the proposed project types. Materials added to the riverbed and equipment working in the river could injure or kill juvenile salmonids. Dewatering and associated fish relocation is expected to remove most salmonids. Juvenile fish that are not relocated are expected to be killed by either dewatering or physical injury from equipment or material placement.

Many instream restoration project types may require the application of gravel or sediment directly to the riverbed, grading of the material, placement of river crossings at some sites, and the use of heavy equipment in the river, thereby increasing the likely exposure and chance for adverse effects to listed juveniles in the area.

During construction activities, both juvenile and adult fish will likely be able to detect upstream disturbance and will typically actively avoid those portions of the stream where a turbidity plume occurs. Occasionally, feeding juvenile salmonids may be attracted to activity stirring up sediment, but whenever they detect an immediate threat, they are expected to quickly move away. Also, the area disturbed by gravel placement or channel excavation and associated turbidity at any given time is expected to be only a portion of the river width; therefore, juvenile salmonids will have opportunities to move to other portions of the channel where they can avoid potential injury or death. Adult salmonids are not expected to be present when instream construction activities requiring dewatering occur. Therefore, a potential impact to adult salmonids from construction is considered extremely unlikely to occur.

Effects to habitat

Exposure

Instream projects such as LWD or gravel additions will likely create short term impacts including increased turbidity and disturbance of macroinvertebrate communities.

Response

Critical habitat Physical and Biological Features (PBFs) of critical habitat for the listed species described above may be adversely impacted due to components of restoration activities. These PBFs include spawning, rearing, and migration habitats. The potential adverse effects to critical habitat are expected to follow the same effects pathways as the effects to species, primarily caused by dewatering, physical disturbance and increased mobilization of sediment. These effects may be caused by a number of different project types, but all are expected to be short-term.

Existing benthic (i.e., bottom dwelling) aquatic macroinvertebrate populations in streams are expected to die when their habitat is disturbed or dewatered, reducing the food available to juvenile salmonids. Such a reduction in food resources would be temporary (maximum time of four months), and rapid recolonization (about one to two months) of disturbed areas by macroinvertebrates is expected following the return of flow to the dewatered area, providing that nearby macroinvertebrate populations have persisted. In addition, the effect of macroinvertebrate loss is likely to be small because 1. the size of the dewatered area is limited and 2. food delivery from upstream sources (via drift) would immediately resume once the stream flow is restored.

Juvenile rearing sites require cover and cool water temperatures during the summer low flow period. Over-wintering juvenile salmonids require refugia during high flows in the winter. Temporary adverse effects to rearing habitat PBFs will primarily occur as a result of dewatering the channel and increased sediment input resulting from instream disturbance. However, these adverse effects are expected to be temporary and of short duration lasting only as long as project construction or until the first fall storm or spring freshet. The activities described in the proposed action will increase the quality of rearing habitat over the long term. Salmonid rearing habitat will be improved by adding complexity that will increase pool formation, cover structures, and velocity refugia.

Instream physical disturbance associated with habitat restoration projects will contribute to habitat diversity and create and maintain foraging, cover, and resting habitat for both adult and juvenile anadromous fish. Placement of instream woody material on the banks of the active channel will create instantly available habitat by creating diverse cover for juvenile rearing. Activities described in the proposed action will improve the quality of spawning habitat over the long term. Spawning habitat will be improved by reducing the amount of sediment that enters the stream through erosion control, and habitat restoration techniques.

Migratory habitat PBFs are essential for juvenile and adult fish that are moving through habitats in the river basin. Migratory habitat PBFs may be affected during the temporary re-routing of the channel during project implementation, however, the Program's General Measures to Limit the Effect of Dewatering Activities and Fish Relocation requires that a migratory corridor will be maintained at all times. The proposed action will also have long-term beneficial effects to migratory habitat. Activities adding complexity to migratory habitat PBFs are expected to increase the number of pools, providing resting areas for adults, and the removal of barriers expected to improve access to habitat.

Spatially explicit in-water work windows are designed to avoid impacts to salmonid spawning habitat during the spawning season(s) and egg incubation. The limited cases of affected salmonid spawning habitat PBFs are expected to include temporary increases in fine sediment resulting from proposed activities. Spawning habitat is located where water velocities are higher, where mobilized fine sediment is less likely to settle. Where limited settling does occur in spawning habitat, the minimally increased sediment is not expected to degrade spawning habitat due to the small amounts and short-term nature of the effects.

Increased Mobilization of Sediment

Description of effects and project types these effects may result from

All project types involving ground disturbance in or adjacent to streams and estuarine areas are expected to increase turbidity and suspended sediment levels within the project work site and downstream and adjacent areas. The re-suspension and deposition of instream sediments is an indirect effect of construction equipment and gravel entering the river. Short-term increases in turbidity and suspended sediment levels associated with construction may negatively impact fish temporarily through reduced availability of food, reduced feeding efficiency, and exposure to sediment released into the water column.

Relevant BMPs, program rules and design elements.

All projects will include the measures outlined in this PBA, which address and minimize potential effects from increases in mobilization of sediment. Therefore, water quality degradation from increased mobilization of sediment is expected to be minimal.

Effects to species

Exposure

Because the region-specific in-water work windows are designed to avoid the non-migratory life stages, the species and life stages most likely to be exposed to increases in mobilization of sediment are juvenile salmonids. While migrating adult salmonids may be present, their mobility will allow them to avoid construction areas. However, low numbers of juvenilesalmonidsmay be present in each project site.

Response

Short-term increases in turbidity are anticipated to occur during dewatering activities and/or during construction. Research with salmonids has shown that high turbidity concentrations can: reduce feeding efficiency, decrease food availability, reduce dissolved oxygen in the water column, result in reduced respiratory functions, reduce tolerance to diseases, and can also cause fish mortality (Berg and Northcote 1985, Gregory and Northcote 1993, Velagic 1995, Waters 1995). Mortality of very young coho salmon and steelhead fry can result from increased turbidity

(Sigler et al. 1984). Even small pulses of turbid water will cause salmonids to disperse from established territories (Waters 1995), which can displace fish into less suitable habitat and/or increase competition and predation, decreasing chances of survival. Nevertheless, much of the research mentioned above focused on turbidity levels significantly higher than those likely to result from the proposed restoration activities, especially with implementation of the proposed conservation measures. In addition, streams subject to infrequent episodes adding small volumes of sediment to the channel may not experience dramatic morphological changes (Rogers 2000).

The slightly elevated concentrations of sediment and turbidity expected from the proposed restoration activities are unlikely to be severe enough to cause injury or death of listed juvenile salmonids. Instead, the anticipated minor levels of turbidity and suspended sediment resulting from instream restoration projects will likely result in only temporary behavioral effects. Recent monitoring of newly replaced culverts in Humboldt County, California detailed a range in turbidity changes downstream of newly replaced culverts following winter storm events (Humboldt County 2002, 2003 and 2004). During the first winter following construction, turbidity rates (NTUs) downstream of newly replaced culverts increased an average of 19 percent when compared to measurements directly above the culvert. However, the range of increases within the 11 monitored culverts was large (n=11; range 123% to -21%). Monitoring results from one- and two-year-old culverts were much less variable (n=11; range: 12% to -9%), with an average increase in downstream turbidity of one percent. Although the culvert monitoring results show decreasing sediment effects as projects age from year one to year three, a more important consideration is that most measurements fell within levels that were likely to only cause slight behavioral changes [e.g., increased gill flaring (Berg and Northcote 1985), elevated cough frequency (Servizi and Marten 1992), and avoidance behavior (Sigler et al. 1984)]. Turbidity levels necessary to impair feeding are likely in the 100 to 150 NTU range (Gregory and Northcote 2003, Harvey and White 2008). Importantly, proposed minimization measures will likely ensure that future sediment effects from fish passage projects will be small.

Sediment effects generated by each individual project will likely impact only the immediate footprint of the project site and habitat located immediately downstream. Studies of sediment effects from culvert construction determined that the level of sediment accumulation within the streambed returned to control levels between 358 to 1,442 meters downstream of the culvert (LaChance et al. 2008). Because of the multiple measures to minimize sediment mobilization, described in sections 2.5 and 2.6, downstream sediment effects from the proposed restoration projects are expected to extend downstream for a distance consistent with the range presented by LaChance et al. (2008). The temporal and spatial scale at which project activities are expected to occur will also likely preclude significant additive sediment related effects. Finally, effects to instream habitat and fish are expected to be short-term, since most project-related sediment will likely mobilize during the initial high-flow event the following winter season.

Effects to habitat

Exposure

Habitat in the project reach may be exposed to increases in sediment and decreases in water quality during and immediately following project implementation. Additionally, increases in sediment and decreases in water quality may occur following initial precipitation events post project.

Response

Critical habitat Physical and Biological Features (PBFs) of critical habitat for the listed species described above may be adversely impacted due to components of restoration activities. These PBFs include spawning, rearing, and migration habitats. The potential adverse effects to critical habitat are expected to follow the same effects pathways as the effects to species, primarily caused by dewatering, physical disturbance and increased mobilization of sediment. These effects may be caused by a number of different project types, but all are expected to be short-term.

Filling channels with sediment

Description of effects and project types these effects may result from

Channel filling, or Stage Zero projects, are a relatively new process-based approach to channel restoration in California. This method can include construction of a Geomorphic Grade Line (GGL) based on geographic information system (GIS) and field-based analyses, basically filling incising channels and installing floodplain elements to provide roughness. Many of the other project activities described in this PBA are often included in stage zero projects including improvements to secondary channels and wetland habitats, setting back or removing existing berms, dike, and levees, installing habitat forming instream structures, and planting riparian vegetation. These activities will aid in the re-establishment of hydrologic regimes, increase the area available for rearing habitat, improve access to rearing habitat, increase the hydrologic capacity of side channels, increase channel diversity and complexity, provide resting areas for fish at various levels of inundation, provide flood water attenuation, nutrient and sediment storage, and establish and augment native plant communities.

Relevant BMPs, program rules and design elements.

All projects will include the measures outlined in this PBA, which address and minimize potential effects from placing sediment in channels. Therefore, water quality and habitat degradation from sediment is expected to be minimal.

Effects to species

Exposure

During the first flush of the rainy season, turbidity is expected to be higher than during subsequent precipitation events, although nearly the entire surface area of these projects will be pervious area where effects of the first flush may not be as significant as following periods of peak flows. Temporary impacts from construction activities, channel filling and floodplain excavation are anticipated to be similar as in other restoration project types and will be short term in nature. Individuals located downstream of these projects will be exposed to increased turbidity levels, changes in suspended sediment concentrations, and short term decreases in feeding efficiencies. All projects that involve streambank excavation and channel fill resulting in bare earth exposure will include erosion controls, revegetation plans, and riparian fencing which will minimize the potential for exposure to individuals. Exposure to these conditions will be short term and individual salmonids can migrate downstream to areas where these effects have been further decreased to an insignificant level. All in-water construction will occur during the site-specific, in-water work windows and include site dewatering to minimize effects to spawning and migration.

Response

Responses to channel filling projects on individual salmonids are anticipated to be similar to those described above in the mobilization of sediment section. Following short term adverse effects, channel filling projects will result in improved habitat conditions, and habitat forming processes which will provide a benefit to populations. Increased vegetation and habitat complexity will improve thermal regulation, hydrologic and nutrient cycling, channel formation and sediment storage, floodplain development and energy dissipation all improving habitat condition and individual success. The medium to long term impacts of the restoration using stage zero techniques will serve to connect healthy riparian vegetation and habitat to existing, larger patches above and below the project footprint, thereby improving habitat connectivity and passage conditions.

Effects to habitat

Exposure

Habitat in the project reach may be modified or temporarily reduced during and immediately following project implementation. Additionally, increases in sediment and decreases in water quality may occur following initial precipitation events post project. Macroinvertebrate communities will likely be reduced initially, but return as the flow is reconnected and food sources drift back into the project footprint.

Response

Critical habitat Physical and Biological Features (PBFs) of critical habitat for the listed species described above may be adversely impacted due to components of restoration activities. These PBFs include spawning, rearing, and migration habitats. The potential adverse effects to critical habitat are expected to follow the same effects pathways as the effects to species, primarily caused by dewatering, physical disturbance and increased mobilization of sediment. These effects may be caused by a number of different project types, but all are expected to be short-term. The response of habitat to the effects of activities associated with filling channels with sediment are described below.

Disturbance to Riparian Vegetation and Aquatic Habitat

Description of effects and project types these effects may result from

The loss and disturbance of riparian and aquatic habitat is an indirect effect of creating and maintaining temporary access points to and across the river, covering vegetation with gravel, as well as a direct effect of temporary removal for floodplain and side channel enhancement. In general, the restorative nature of restoration projects is to improve habitat conditions for salmonids, and thus, riparian vegetation disturbance is expected to be avoided, as practicable. However, there may be limited situations where avoidance is not possible. Aquatic and riparian habitat disturbance may result from a variety of project types.

Relevant BMPs, program rules, and design elements

The potential impacts to listed species and critical habitat will be minimized through implementation of applicable BMPs and minimization measures outlined in the PBA. In the event that streamside riparian vegetation is removed, the loss of riparian vegetation is expected to be small, due to minimization measures, and limited to mostly shrubs and an occasional tree. Impacts to existing vegetation will be avoided to the extent practicable. Disturbed riparian areas, not intended for future road access or gravel placement, will be revegetated with native plant species and mulched with certified weed-free hay, within a year (timed to maximize survival) following the completion of construction activities. Most proposed fisheries restoration actions are expected to avoid disturbing riparian vegetation through the proposed conservation measures. In general, the restorative nature of these projects is to improve habitat conditions for salmonids, and thus, riparian vegetation disturbance is expected to be avoided, as practicable. However, there may be limited situations where avoidance is not possible. See the Protection, Avoidance and Minimization Measures section for a complete list of general minimization measures that could be utilized during these projects.

Effects to species

Exposure

During the period June 30-November 1, primarily only the juvenile life stages of salmonids may be present in the Program area and have the potential to be exposed to the effects of the above described disturbance. See the status of the species section for more information about life history of all species that may be exposed during project implementation. While migrating adult fish may be present, their mobility will allow them to avoid the construction areas.

Response

Although juveniles are expected to avoid areas where equipment is being used to conduct habitat restoration, some juvenile salmonids may attempt to find shelter in the substrate and be injured or need to flee which may cause decreases in energy and fitness. Development of equipment access related to many of the proposed restoration project types may require the application of gravel directly to the riverbed, grading of the existing bed material, placement of river crossings at some sites, and the use of heavy equipment in the river, thereby increasing the likely exposure and chance for adverse effects to listed juvenile salmonids in the area.

During construction activities, both juvenile and adult fish will likely be able to detect areas of disturbance and will typically actively avoid those portions of the project footprint where equipment is operated or a turbidity plume occurs. Occasionally, feeding juvenile salmonids may be attracted to activity stirring up sediment, but whenever they detect an immediate threat, they are expected to quickly move away. Also, the area disturbed by gravel placement or channel excavation and associated turbidity at any given time is expected to be only a portion of the river width; therefore, juveniles will have opportunities to move to other portions of the channel where they can avoid potential injury or death. Adult salmonids are expected to move out of the area to adjacent suitable habitat before equipment enters the water. Therefore, a potential impact to adult salmonids from construction site access is considered extremely unlikely to occur.

Effects to habitat

Exposure

Disturbance to aquatic and riparian habitat will result in a temporary change and potential short term loss of function in the project reach. Additionally, aquatic organisms, including benthic prey items will be exposed to short term changes in availability of the stream channel and adjacent riparian areas. These effects will last for the duration of the disturbance event and may persist in varying amounts following site restoration. Indirect impacts of invasive species removal include the potential for short-term loss of shading and habitat provided by the invasive plants. Herbicide use for removal of invasive plant species could cause short-term impacts to sensitive fish species and is fully described in the Toxic Chemicals section below. Indirect impacts of project site access activities include the alteration and loss of aquatic habitat and a temporary increase in turbidity. With the application of the avoidance and minimization measures described in the proposed action, it is anticipated that there would be minimal loss of riparian vegetation and aquatic habitat, which is not expected to reduce habitat function within the action area.

Response

Critical habitat Physical and Biological Features (PBFs) of critical habitat for the listed species described above may be adversely impacted due to components of restoration activities. These PBFs include spawning, rearing, and migration habitats. The potential adverse effects to salmonid critical habitat are expected to follow the same effects pathways as the effects to species, primarily caused by dewatering, physical disturbance and increased mobilization of sediment. These effects may be caused by a number of different project types, but all are expected to be short-term.

Impacts to riparian vegetation and aquatic habitat will be avoided to the maximum extent practicable. Disturbed riparian areas, not intended for future road access or gravel placement, will be revegetated with native plant species and mulched with certified weed-free hay within a year (timed to maximize survival) following the completion of construction activities. The temporary loss of riparian vegetation is an effect of creating and maintaining temporary access points to the river, caused by covering vegetation with gravel; as well as a direct effect of temporary removal for floodplain and side channel enhancement.

Overall, the above described restoration projects will result in a long term beneficial effect on aquatic and riparian habitat. Following completion of the project, the habitat in the project reach is expected to fully recover over time and provide an increase in habitat quality and quantity for individuals in the project reach.

Noise, Motion, and Vibration Disturbance

Description of effects and project types these effects may result from

Noise, motion, and vibration disturbance produced by heavy equipment operation are expected at most instream restoration sites. In-water pile driving could also cause barotrauma, but we do not anticipate this activity occurring as often as disturbance from heavy equipment.

Relevant BMPs, program rules and design elements

The use of equipment, which will occur primarily outside the active channel, and the infrequent, short-term use of heavy equipment in the wetted channel, is expected to minimize adverse effects to listed fishes. Further, in-water pile driving will be conducted consistent with measures outlined in the in-water pile driving section above will ensure that effects are avoided or minimized.

Effects to species

Exposure

Noise, motion, and vibration produced by heavy equipment operation, including pile driving, are expected at most instream restoration sites. However, the use of equipment, which will occur primarily outside the active channel, and the infrequent, short-term use of heavy equipment in the wetted channel, is expected to result in insignificant adverse effects to listed fishes. Further, in-water pile driving will be conducted consistent with measures outlined above which will ensure that effects are avoided or minimized. Listed salmonids will be able to avoid interaction with instream and estuarine machinery by temporarily relocating to suitable habitat either upstream or downstream or into suitable habitat adjacent to the worksite.

The low number of juveniles expected to be injured or killed as a result of barotrauma is based on the avoidance behavior of juveniles to disturbance, the low numbers of juvenile expected to be present within each project site after relocation and dewatering activities and the robust protection measures described under the In-water Pile Driving Protection Measures section of the PBA.

Response

Because the region-specific in-water work windows are designed to avoid the non-migratory life stages, the species and life stages most likely to be exposed to noise disturbance are juvenile salmonids. While migrating adult fish may be present, their mobility will allow them to avoid the construction areas in most cases. However, low numbers of juvenile salmonidsmay be present in each project site.

Effects to habitat

Exposure

Exposure to potential effects from noise, motion and vibration disturbance would occur primarily during project implementation (June 15 - November 1) when heavy equipment, pile driving, or other disturbance activities are taking place. Exposure would be limited because these activities would generally occur in dewatered channels where the fish would be relocated out of the project area.

Response

Critical habitat Physical and Biological Features (PBFs) for the listed species described above may be adversely impacted due to components of restoration activities. The PBF that would likely be affected through noise, motion and vibration are rearing habitats. While noise effects are present in a project area, the habitat would remain minimally occupied until the noise and vibration effects have ceased. Because of the program sideboards, limited heavy equipment use in the wetted channel, and low levels of acoustic impacts, the effects to listed species and their critical habitat would be minimal.

The potential adverse effects to critical habitat are expected to follow the same effects pathways as the effects to species, primarily caused by physical disturbance and increased mobilization of sediment. These effects may be caused by a number of different project types, but all are expected to be short-term.

Toxic Chemicals

Description of effects and project types these effects may result from

The use of heavy equipment creates a risk of accidental spills of fuel, lubricants, hydraulic fluid, coolants, and other contaminants. Petroleum-based contaminants, such as fuel, oil, and some hydraulic fluids, contain polycyclic aromatic hydrocarbons (PAHs), which can be acutely toxic to salmonid fish and other aquatic organisms at high levels of exposure and can cause sub-lethal adverse effects to aquatic organisms at lower concentrations. Equipment refueling, fluid leakage, and maintenance activities within and near the stream channel pose some risk of contamination and potential adverse effects on listed fish. In addition to toxic chemicals associated with construction equipment, water that comes into contact with wet cement during construction of a restoration project can also adversely affect water quality and may harm listed salmonids. Herbicide application and herbicide drift could also adversely affect water quality conditions.

Relevant BMPs, program rules and design elements

All projects will include the measures outlined above, which address and minimize pollution risk from equipment operation. In addition, there is a robust set of BMPs, avoidance and minimization measures, and guidelines to minimize the effects of herbicides in the Herbicide Use Protection Measures section. Several conservation measures reduce the risk of herbicide drift. Ground equipment reduces the risk of drift, and hand equipment nearly eliminates it. Relatively calm conditions, preferably when humidity is high and temperatures are relatively low, and low sprayer nozzle height will reduce the distance that herbicide droplets will fall before reaching weeds or soil. Less distance means less travel time and less drift. Wind velocity is often greater as height above ground increases, so droplets from nozzles close to the ground would be exposed to lower wind speeds. The higher that an application is made above the ground, the more likely it is to be carried by faster wind speeds, resulting in long distance drift. Therefore, water quality degradation from toxic chemicals associated with the habitat restoration projects is expected to be minimal.

Effects to species

Exposure

Because the region-specific in-water work windows are designed to avoid the non-migratory life stages, the species and life stages most likely to be exposed to toxic chemicals are juvenile salmonids. While migrating adult fish may be present, their mobility will allow them to avoid the construction areas in most cases. However, low numbers of juvenile salmonids may be present at or near individual project sites.

We identified three scenarios for the analysis of herbicide application effects: (1) Runoff from riparian application; (2) accidental application within perennial stream channels (e.g., via drift); and (3) runoff from intermittent stream channels and ditches. Each of these could occur via surface water or groundwater. Spray and vapor drift are important pathways for herbicide entry into aquatic habitats. Several factors influence herbicide drift, including spray droplet size, wind and air stability, humidity and temperature, physical properties of herbicides and their formulations, and method of application.

For example, the amount of herbicide lost from the target area and the distance the herbicide moves both increase as wind velocity increases. Under inversion conditions, when cool air is near the surface under a layer of warm air, little vertical mixing of air occurs. Spray drift is most severe under these conditions, since small spray droplets will fall slowly and move to adjoining areas even with very little wind. Low relative humidity and high temperature cause more rapid evaporation of spray droplets between sprayer and target. This reduces droplet size, resulting in increased potential for spray drift. Vapor drift can occur when herbicide volatilizes.

Surface water contamination with herbicides can occur when herbicides are applied intentionally or accidentally into ditches, irrigation channels or other bodies of water, or when soil-applied herbicides are carried away in runoff to surface waters. Direct application into water sources is generally used for control of aquatic species, and is not a component of the proposed action. Accidental contamination of surface waters can occur when irrigation ditches are sprayed with herbicides or when no-application buffer zones around water sources are not wide enough. In these situations, use of hand application methods will greatly reduce the risk of surface water contamination. The minimum buffer we have proposed for ground-based broadcast application is 100 feet, and the minimum buffer with a backpack sprayer is 15 feet (aerial application is not included in the proposed action).

The contribution from runoff will vary depending on site and application variables, although the highest pollutant concentrations generally occur early in the storm runoff period when the greatest amount of herbicide is available for dissolution. Lower exposures are likely when herbicide is applied to smaller areas, when intermittent stream channels or ditches are not completely treated, or when rainfall occurs more than 24 hours after application. Under the proposed action, some formulas of herbicide can be applied within the bankfull elevation of streams, in some cases up to the water's edge (with hand application techniques). Any juvenile fish in the margins of those streams are more likely to be exposed to herbicides as a result of overspray (highly unlikely to occur with hand application only within the buffer), inundation of treatment sites, percolation, surface runoff, or a combination of these factors. Overspray and inundation will be minimized through the use of dyes or colorants and restrictions on application methods.

Groundwater contamination is another important pathway. Most herbicide groundwater contamination is caused by "point sources," such as spills or leaks at storage and handling facilities, improperly discarded containers, and rinses of equipment in loading and handling areas, often into adjacent drainage ditches. Point sources are discrete, identifiable locations that discharge relatively high local concentrations. In soil and water, herbicides persist or are decomposed by sunlight, microorganisms, hydrolysis, and other factors. Proposed conservation measures minimize these concerns by ensuring proper calibration, mixing and cleaning of equipment. Non-point source groundwater contamination of herbicides can occur when a mobile herbicide is applied in areas with a shallow water table. Proposed conservation measures minimize this danger by restricting the formulas used and staging areas, and the time, place and manner of their application to minimize offsite movement.

Herbicides included in this restoration program were selected due to their low to moderate aquatic toxicity to listed salmonids compared to those with higher risk. The risk of adverse effects from the toxicity of herbicides and other compounds present in formulations to listed aquatic species is mitigated by reducing stream delivery potential to water bodies by restricting application methods. Near wetted stream channels, we propose to allow nine aquatic labeled herbicides applied using only hand application methods (wicking/wiping/injection). The associated application methods were selected for their low risk of contaminating soils and subsequently introducing herbicides to streams. However, direct and indirect exposure and toxicity risks are inherent in some application scenarios.

Response

Listed salmonidswill be able to avoid interaction with instream machinery and exposure to chemical contaminants by temporarily relocating into suitable either upstream or downstream into suitable habitat adjacent to the worksite. In addition, the minimum distance between instream project sites and the maximum number of instream projects under the proposed

Program would further reduce the potential aggregated effects of heavy equipment disturbance on listed salmonids.

The effects of the herbicide applications to various representative groups of species have been evaluated for each proposed herbicide. The rainbow trout, a salmonid, is frequently used in standard toxicity tests and serves as a good surrogate for other ESA-listed salmonids. The effects of herbicide applications using spot spray, hand/select, and broadcast spray methods were evaluated under several exposure scenarios: (1) runoff from riparian (above the OHW mark) application along streams, lakes and ponds, (2) runoff from treated ditches and dry intermittent streams, and (3) application within perennial streams (dry areas within channel and emergent plants). The potential for herbicide movement from broadcast drift was also evaluated. Risks associated with exposure and associated effects were also evaluated for terrestrial species.

Although the project design criteria and conservation measures will minimize the risk of drift and contamination of surface and groundwater, any herbicides reaching surface waters will likely result in mortality to fish during incubation, or lead to altered development of embryos. Stehr et al. (2009) found that the low levels of herbicide delivered to surface waters are unlikely to be toxic to the embryos of ESA-listed salmon, steelhead and trout. However, mortality or sub-lethal effects such as reduced growth and development, decreased predator avoidance, or modified behavior may occur. Herbicides are likely to also adversely affect the food base for listed salmonids and other fish, which includes terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.

Effects to habitat

Exposure

Instream habitat may be exposed to chemical contamination during project implementation. Relevant BMPs, as described in the Herbicide Protection Measures Section, will be implemented to ensure that chemical spills and the risk of contamination is minimized and avoided as practically feasible.

Response

Critical habitat Physical and Biological Features (PBFs) of critical habitat for the listed species described above may be adversely impacted due to components of restoration activities. These PBFs include spawning, rearing, and migration habitats. The potential adverse effects to critical habitat are expected to follow the same effects pathways as the effects to species, primarily caused by dewatering, physical disturbance and increased mobilization of sediment. These effects may be caused by a number of different project types, but all are expected to be short-term.

The response of habitat and aquatic organisms inhabiting the project reach will occur during any chemical spill and may result in decreases in health or mortality of benthic invertebrates or other aquatic organisms in the stream reach. This response would be short term in nature and would not have a significant effect on listed species as individuals will be able to utilize prey items in adjacent reaches of the stream. Additionally, all projects include BMPs and spill avoidance measures that will ensure any chemical contamination is immediately cleaned up and kept localized so as to not expose adjacent areas. Once the spill is contained and cleaned up the habitat in the area is expected to return to full function.

For herbicides, the proposed conservation measures, including limitations on the herbicides, adjuvants, carriers, handling procedures, application methods, drift minimization measures, and riparian buffers, will greatly reduce the likelihood that significant amounts of herbicide will be transported to aquatic habitats, although some herbicides are still likely to enter streams through aerial draft, in association with eroded sediment in runoff, and dissolved in runoff, including runoff from intermittent streams and ditches. Some individual fish are likely to be negatively impacted as a consequence of that exposure. The long-term consequences of invasive, non-native plant control will depend on the success of follow-up management actions to exclude undesirable species from the action area, and establish a secure native plant community that supports suitable habitat for salmon and steelhead.

Effects to Listed Green Sturgeon and Eulachon and their Critical Habitat

Green Sturgeon

Low numbers of adult SDPS green sturgeon may be present at or near project sites within Humboldt Bay and other estuarine areas during construction. Any minor increases in sediment and turbidity that convey to the estuary environment from tributaries will quickly dissipate within the larger spatial area of the receiving water body. Temporary increases in turbidity related to construction activities and dredging within the estuary are not expected to reduce feeding opportunities nor the fitness of SDPS green sturgeon individuals, a species which is known to rely on other senses over eyesight. Therefore, the effects of turbidity from the proposed action are expected to be insignificant to SDPS green sturgeon.

The proposed action may result in the temporary loss of some benthic food resources within the area where dredging or impacts to the substrate may occur. The majority of SDPS green sturgeon are found in the North Bay and Entrance Bay, and most will not be exposed to effects. Because prey resources will only be temporarily affected, and there is ample suitable habitat elsewhere, we do not expect any fitness related consequences to individuals and therefore conclude that effects of a temporary reduction in benthic prey would be insignificant.

The PBFs of green sturgeon critical habitat occur both in the estuarine and coastal marine areas of the action area. The PFBs of green sturgeon within the estuarine area include: (1) abundant food items and substrates for juvenile, subadult and adult life stages; (2) water flow necessary for orientation and attraction flows to spawning areas in the Sacramento River; (3) water quality necessary for normal behavior, growth, and viability of all life stages; (4) a migratory pathway necessary for the safe and timely passage within estuarine habitats and between estuarine and riverine or marine habitats; (5) a diversity of depths necessary for shelter, foraging and migration of juvenile, subadult, and adult life stages; and (6) sediment quality necessary for normal behavior, growth, and viability of all life stages (NMFS 2006).

The temporary reduction in benthic prey resources during the recovery and recolonization of the dredge footprint after dredging episodes is not expected to adversely affect the Prey Resources PBF for SDPS green sturgeon.

The established criteria for suitable water temperatures, salinity, dissolved oxygen, and contaminants for all life stages of SDPS green sturgeon. The action is not expected to affect Water Quality PBF quality parameters as the activities will not significantly affect temperature, salinity, or dissolved oxygen. Minimization measures are likely to avoid introducing significant amounts of contaminants (fuel, etc.) into the action area. Such toxics would be further diluted by tides and currents. Thus, there are no adverse effects expected to the Water Quality PBF.

The Migratory Corridor for SDPS green sturgeon may be temporarily affected by increases in turbidity. It is not expected that turbidity will affect SDPS green sturgeon migratory behaviors as the species has reduced eyesight and relies on other senses to navigate. Therefore, the effects to the Migratory Corridor PBF are expected to be insignificant.

We do not expect adverse effects to the Water Depth PBF, as a diversity of depths will remain available to all SDPS green sturgeon in the action area.

The Sediment Quality PBF identifies the importance of the chemical characteristics of sediments, and suggests that sediments be free of elevated levels of contaminants such as selenium, pesticides, or poly aromatic hydrocarbons. These chemicals are known to cause adverse effects on all life stages of green sturgeon. Due to minimization measures the proposed action is not expected to contribute chemical contamination to the water in the action area in more than the small amounts that are re-suspended from the bottom during dredging activities. Therefore, we do not expect adverse effects to the Sediment Quality PBF.

Eulachon

We do not anticipate eulachon will be present during restoration project implementation due to the proposed work windows (June 15 - November 1) not coinciding with when adult and juvenile eulachon will be in the action area (winter - spring) and we don't expect eulachon will be encountered in the Klamath and Mad rivers and in estuarine areas while implementing restoration projects and while performing effectiveness monitoring in estuarine areas. Therefore all of the effects of the action would be discountable for individual eulachon.

While the proposed action within specific project footprints could disturb spawning substrate, the streambed would return to a natural condition after the first few heavy rains of winter. Other potential impacts to eulachon critical habitat (e.g., sedimentation, riparian disturbance) are described in the Effects of the Action section above for Salmon and Steelhead, and would apply to eulachon critical habitat as well. Based on these analyses, none of the other potential impacts would be significant.

V. ESTIMATES OF FISH RELOCATED, HANDLED DURING MONITORING, AND RELATED FISH LOSSES

Table 2 depicts the anticipated number of fish that will be handled based on historic monitoring data, prior fish relocation efforts from the 2012 RC PBO, and existing population data. The number of fish potentially encountered for effectiveness monitoring has been broken down into those observed, captured/handled/released/ and pit tagged. These numbers were estimated by considering the RC's prior years' 4(d) numbers, the potential to encounter a specific habitat unit that has a very robust population, and the amount of PIT tags needed to produce a robust estimate for predicting residence time, growth rates and localized population estimates. The estimated numbers were increased for the Upper Klamath Population because over 400 miles of habitat will be opened up after the Klamath dam removal project and we anticipate encountering additional fish as their habitat ranges expand.

Although the BMP's and avoidance and minimization measures outlined in the PBA will reduce the number of fish exposed to barotrauma, we do anticipate potential effects to juvenile fish from blasting and pile driving and have included those estimates in the tables below.

Of those fish handled through relocation, barotrauma effects and effectiveness monitoring, we do not anticipate more than 3% mortality for each species.

Table 2. Annual estimates of juvenile coho (a), steelhead (b), and Chinook (c)relocated during restoration actions, (including those affected by barotrauma) and handled during effectiveness monitoring activities and their anticipated mortality effects.

SONCC Coho Diversity Stratum	Monitoring Capture/Handle/ Release	PIT tagging related to monitoring	Fish capture and relocation for restoration projects (including fish exposed to barotrauma)	Anticipated Mortality (3%)
Central Coastal	2500	600	500	108
Southern Coastal	3000	800	500	129
Interior Klamath	4000	1500	1000	195
Interior Trinity	500	100	500	33
Interior Eel	3000	800	500	129
Total	**13000**	**3800**	**3000**	**594**

a. Annual SONCC coho encounters and associated estimated mortality.

NC Steelhead Diversity Stratum	Monitoring Capture/Handle/ Release	PIT tagging related to monitoring	Fish Capture and Relocation for Restoration Projects (including fish exposed to barotrauma)	Anticipated Mortality (3%)
Northern Coastal	2500	400	400	99
Lower Interior	2500	400	400	99
North Mountain Interior	2500	400	400	99
Total	**7500**	**1200**	**1200**	**297**

b. Annual NC steelhead encounters and associated estimated mortality.

CC Chinook Diversity Stratum	Monitoring Capture/Handle/ Release	PIT tagging related to monitoring	Fish Capture and Relocation for Restoration Projects (including fish exposed to barotrauma)	Anticipated Mortality (3%)
North Coastal	1500	400	500	72
North Mountain Interior	1500	400	500	72
Total	**3000**	**800**	**1000**	**144**

c. Annual CC Chinook encounters and associated estimated mortality.

VI. EFFECTS DETERMINATIONS FOR LISTED SPECIES AND DESIGNATED CRITICAL HABITAT

This section summarizes the results of the NOAA RC and Corps analysis of effects related to Program activities for 3 listed salmonid populations, green sturgeon, eulachon and their critical habitats. The majority of our impacts will be affecting juvenile salmonids and their critical habitat through dewatering of habitat and relocation of individuals. We do not anticipate effects to eulachon during our restoration project implementation due to the proposed work windows (June 15 - November 1) not coinciding with when adult and juvenile eulachon will be in the action area (winter - spring), and we do not expect eulachon will be encountered in the Klamath and Mad Rivers and in estuarine areas while performing effectiveness monitoring. In addition, we do anticipate, on rare occasions, minor effects to adult green sturgeon in the Humboldt Bay estuarine areas during summer estuary restoration projects through a minor increase in turbidity. The specific effects to salmonids, green sturgeon and eulachon are described above in section IV, Effects of the Proposed Action.

Based upon our Biological Assessment, the NOAA RC and the Corps have reached the following determinations with regard to federally-listed species and designated critical habitats:

Table 3. Action Agency Determinations.

ESA-Listed Species	Listing Status	Species Determination	Critical Habitat Determination
Southern Oregon/Northern California Coast (SONCC) coho salmon	Threatened	LAA	LAA
California Coastal (CC) Chinook salmon	Threatened	LAA	LAA
Northern California (NC) steelhead	Threatened	LAA	LAA
Southern Pacific Eulachon DPS	Threatened	NLAA	NLAA
Southern North American Green Sturgeon DPS	Threatened	NLAA	NLAA

VII. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this opinion. 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 Act. The Action Agencies are not aware of future State (except as described below), tribal, local, or private actions reasonably certain to occur that will affect the action area that are not already considered under separate ESA Section 7 consultation.

Non-federal actions that may affect the action area include angling and state angling regulation changes, agricultural practices, private water contracts, water withdrawals and diversions, adjacent mining activities, and increased population growth resulting in urbanization and development of floodplain habitats, which may increase urban/suburban runoff and affect water quality. Increased water turbidity levels for prolonged periods of time may result from agricultural practices, adjacent mining activities, and increased urbanization and/or development of riparian habitat, and could adversely affect the ability of young salmonids, eulachon and sturgeon to feed effectively, resulting in reduced growth and survival. Turbidity may cause harm, injury, or mortality to juvenile coho salmon, Chinook salmon, steelhead, eulachon and sturgeon in the vicinity and downstream of the project area. High turbidity concentration can cause fish mortality, reduce fish feeding efficiency and decrease food availability (Berg and Northcote 1985). Farming and ranching activities within or adjacent to the action area may have negative effects on water quality due to runoff laden with agricultural chemicals. In addition, water withdrawals and diversions may result in entrainment of individuals into unscreened or improperly screened diversions, and may result in depleted river flows that are necessary for migration, spawning, rearing, and flushing of sediment from spawning gravels, gravel recruitment, and transport of large woody debris.

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IX. EFH CONSULTATION

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

Section 305(b) of the MSA directs Federal agencies to consult with NMFS on all actions or proposed actions that may adversely affect Essential Fish Habitat (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.

EFH for Pacific Coast Salmon has been described in Appendix A of Amendment 14 to the Pacific Coast Salmon Fishery Management Plan (FMP). The RC's administration of the Program to fund or authorize implementation of habitat restoration activities will affect streams within the action area described in the programmatic biological assessment. The MSFCMA regulates species managed under FMPs. Fisheries for coho salmon and Chinook salmon are managed under the Pacific Coast Salmon FMP, whereas there are no steelhead fisheries managed under MSFCMA. Therefore this EFH consultation does not address steelhead.

Pacific coast salmon, Pacific Coast Groundfish, and Coastal Pelagic Species EFH may be adversely affected by the proposed action. The Pacific Coast Groundfish FMP (2008) applies to several species including elasmobranchs, roundfish, rockfish and flatfish; and the Coastal Pelagics Species FMP (PFMC 1998) applies to northern anchovy and Pacific sardine.

Essential Fish Habitat Affected by the Project

Essential Fish Habitat is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. 1802[10]). "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle (50 CFR 600.10). The term "adverse effect" means any impacts which reduce the quality and/or quantity of EFH. Adverse effects may include direct or indirect physical, chemical, or biological alterations of the waters or substrates and loss of, or injury to, benthic organisms, prey species, and their habitats, and other ecosystem components, if such modifications reduce the quality and/or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside of it and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.910). The EFH consultation mandate applies to all species managed under a Fishery Management Plan (FMP) that may be present in the action area.

The Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species FMP's contain EFH that will be adversely affected by the Project. Furthermore, some areas where restoration projects and effectiveness monitoring will be implemented are located in a Habitat Area of Particular Concern (HAPC) for federally managed fish species under the Pacific Coast Salmon FMP and Pacific Coast Groundfish FMP. HAPC are described in the regulations as subsets of EFH that are identified based on one or more of the following considerations: the importance of the ecological function provided by the habitat; the extent to which the habitat is sensitive to human-induced environmental degradation; whether, and to what extent, development activities are, or will be stressing the habitat type; and the rarity of the habitat type (50 CFR 600.815(a)(8)). Designated HAPC are not afforded any additional regulatory protection under MSA; however, federal projects with potential adverse impacts to HAPC are more carefully scrutinized during the consultation process. Designated HAPC for Pacific Coast Salmon and Pacific Coast Groundfish FMP within the action area include: submerged aquatic vegetation and seagrass; estuary; and complex channel and floodplain habitat.

This action will apply to portions of the following counties in California and Oregon: Mendocino, Humboldt, Del Norte, Siskiyou, Trinity, Klamath (OR), Jackson (OR) and Lake (OR). Restoration and effectiveness monitoring activities will typically occur in watersheds and estuaries subjected to significant levels of logging, road building, urbanization, mining, grazing, and other activities that have reduced the quality and quantity of instream and estuarine habitat available for Pacific Coast Salmon, Pacific Coast Groundfish and Coastal Pelagics.

Estuaries in the action area may be adversely affected for Pacific Groundfish and Coastal Pelagic Species. Many of these estuaries contain eelgrass (Zostera marina), which is also designated as EFH-HAPCs for Groundfish. EFH for Coastal Pelagic species includes estuaries and ocean waters outward to the limit of the U.S. exclusive economic zone.

Adverse Effects on Essential Fish Habitat

EFH will likely be adversely affected by implementation of the Program.

Anticipated adverse effects to EFH for Coastal Pelagic Species and to EFH and HAPC's of Pacific Coast Salmon and Pacific Coast Groundfish in the action area include:

1. Temporary construction-related effects including dewatering, dredging, acoustics, and water quality degradation will cause adverse effects to EFH of all three FMP's, and adverse effects to the Complex Channel and Floodplain Habitat HAPC, Estuary HAPC, and Submerged Aquatic Vegetation HAPC. It is anticipated that some short term sediment and turbidity will occur up to

about 1500 feet downstream of the project locations. Increased turbidity could further degrade already degraded habitat conditions in many of the proposed project locations.

2. Construction work will temporarily disrupt and remove prey items for all managed species in small portions of the action area in and directly adjacent to restoration project sites. This includes removals and mortalities of managed species (such as northern anchovies) during construction work. Flowing water may be temporarily diverted around some projects, resulting in short-term loss of habitat space and short-term reductions in macro-invertebrates (food for salmon). Chemical spills from construction equipment may occur, but the NOAA RC and Corps believe the chance of spills is low based on the avoidance and minimization measures to be implemented when heavy construction equipment is used.

The duration and magnitude of direct effects to EFH associated with implementation of individual conservation projects will be significantly reduced due to the multiple minimization measures utilized during project implementation. The temporal and spatial scales at which individual restoration project activities are expected to occur from the proposed action will likely preclude significant additive effects.

Implementation of the proposed restoration activities is expected to improve the function and value of EFH and short-term adverse effects will be offset by anticipated long-term benefits.

IV. CONCLUSION

After reviewing the effects of the project, the habitat conservation measures included in the project description, and expected spatial and temporal scales of project activities, the NOAA RC and Corps conclude that the project action, as proposed, will adversely affect the EFH of coho or Chinook salmon within streams and estuaries currently or historically supporting these species and EFH for Pacific Groundfish and Coastal Pelagic Species within Humboldt Bay and other estuaries.

Table 4. Essential Fish Habitat NOAA RC and Corps determinations

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?
Pacific Coast Salmon	Yes
Pacific Coast Groundfish	Yes
Coastal Pelagic Species	Yes

Appendix 1 - Programmatic Application Form

APPLICATION FOR PROGRAMMATIC INCLUSION OF RESTORATION PROJECTS IN NORTHERN CALIFORNIA

INSTRUCTIONS

- Read through the Programmatic Biological Assessment (BA) to determine if the project fits within the described activities and required measures.
- Fill out the application below
- Review the list of specific and general "Protection, Avoidance and Minimization Measures" and guidelines for each project type.
- Sign and date the application
- Attach a map and photos of the project site and other required documentation such as a dewatering plan, designs, etc. (see pg. 2 of this form)
- Submit the completed form to the NOAA Restoration Center by emailing it to bob.pagliuco@noaa.gov

General Information

Applicant Name:

Landowner Name:

Project Name:

Project Location:

Stream: Latitude:

Watershed: Longitude:

Project Start Date:

Project End Date:

Project Inclusion

How is your project expected to be included in the Programmatic BO?

- ☐ The project is receiving technical assistance and/or funding from the NOAA Restoration Center
- ☐ The project is expected to require a permit from the U.S Army Corps of Engineers

Which NMFS protected species will be affected by the project?

- ☐ Southern Oregon Northern California Coast (SONCC) Coho
- ☐ Coastal California (CC) Chinook Salmon

- ☐ Northern California (NC) Steelhead
- ☐ Green Sturgeon, Southern DPS
- ☐ Eulachon, Southern DPS

Before completing this section, read all relevant sections of the Programmatic Biological Assessment this application pertains to. Select project type(s) that apply to the work proposed and attach the required documents that have been outlines below.

- ☐ Improvements to Stream Crossings and Fish Passage (see pg. 12)
- ☐ Removal of small dams, tide gates, and other legacy structures (see pg. 13)
- ☐ Riparian restoration and protection (see pg. 17)
- ☐ Restoration and enhancement of off-channel and side-channel habitat (see pg. 20)
- ☐ Floodplain restoration (see pg. 21)
- ☐ Establishment, restoration and enhancement of tidal, subtidal and freshwater wetlands (see pg. 23)
- ☐ Water conservation projects for enhancement of fish and wildlife habitat (see pg. 26)
- ☐ Removal of pilings and other in-water structures (see pg. 27)
- ☐ Instream restoration (see pg. 28)
- ☐ Upslope watershed restoration (see pg. 31)

  ____

Additional information provided with application (as required for specific project activities) - select all that apply

- ☐ Pre-project photo monitoring data are attached (required for all projects)
- ☐ Map(s) of the project site (required for all projects)
- ☐ Project design plans (required for all projects)
- ☐ Dewatering plan
- ☐ Fish relocation plan
- ☐ Revegetation plan
- ☐ Pile driving plan
- ☐ Hydroacoustic analysis
- ☐ Dredging operations and dredging materials management plan
- ☐ Operation and Maintenance Plan (fish screening projects)
- ☐ 1600 notification or agreement as applicable and proof of water rights (fish screening and water conservation projects)

Will the project involve (check all that apply):

- ☐ Dewatering of more than 1,000 contiguous feet of stream at any given time in one season
- ☐ Use of riprap, RSP or any other form of bank protection
- ☐ Over 100 acres of floodplain reconnection
- ☐ A dam that is higher than 25 feet and/or impounds over 2000 acre feet
- ☐ A dam under FERC jurisdiction
- ☐ Installation of a flashboard dam, head gate, or other mechanical structure.
- ☐ Construction of a new fish ladder
- ☐ Placement of a tide gate where one did not previously exist
- ☐ Restriction of tidal exchange
- ☐ Use of gabion baskets
- ☐ Use of chemically treated timbers used for grade or channel stabilization structures, bulkheads, overwater structures or other instream structures
- ☐ A permanent net loss of habitat, habitat function or functional value for any Covered Species
- ☐ Net loss of eelgrass resources

Project Description

Have the project designs been reviewed or developed in conjunction with a NMFS/CDFW/USFWS agency engineer/technical specialist? If so, provide the name of the reviewer, what they reviewed, and when:

Describe the current problem this project will address and the watershed context of the issue:

Describe the solution proposed that will help address the problem, including project goals and objectives:

Describe the detailed project implementation plan, including: construction duration and start- and end-dates, the materials, techniques and equipment that will be used, dimensions (acres/square ft) of the project footprint, feet of stream dewatered or disturbed at any one time in a given season, acreage of staging areas and access roads needed and how the work will be sequenced. Also describe which year of construction will be implemented if this project will be implemented over several years:

Describe pre-and post-project monitoring that will occur to conform to the conditions of this BO, plus any additional monitoring you will elect to complete to evaluate project effectiveness:

Describe specific minimization and avoidance measures that are planned as part of the project, including those required by the Programmatic BO for specific project type:

If an applicant is also seeking a California Endangered Species Act Consistency Determination for take of juvenile SONCC Coho associated with a project that is included under this program, provide estimates of maximum numbers of individuals taken below.

Covered Species	Estimated Maximum Number Captured	Estimated Maximum Number of Mortalities
SONCC Coho		

Your signature below verifies that you agree to adhere to all conditions of the PBO during project design and implementation.

____

Name Date

Appendix 2 - PBO Reporting Table

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1	**General Information**				**Project Location**						**Project stage (year)**		**Project Type**			**Effects to Species**					
2								**Project Diversty Stratum**								**SONCC coho**		**NC steelhead**		**CC Chinook**	
3	**Project Number**	**Project name**	**Applicant affiliation**	**Variance requested? (yes/no)**	**Name of HUC-12 (dropdown menu of possible HUC-12 names)**	**Latitude (decimal degrees)**	**Longitude (decimal degrees0**	**SONCC coho salmon**	**NC steelhead**	**CC Chinook Salmon**	**year of project construction (0, 1, 2, 3, etc.) (dropdown menu) [year zero means included under PBO that year but no field work had yet occurred]**	**total number years of project construction anticipated (1, 2, 3, 4?).**	**Project Type (dropdown menu of all possible types) [types described in PBA]**	**Small Dam? (Yes/No)**	**Large floodplain project? (Yes/No)**	**# relocated**	**# killed**	**# relocated**	**# killed**	**# relocated**	**# killed**
4																					
5																					
6																					
7																					
8																					
9																					
10																					