UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

Refer to NMFS No: WCR-2017-8532

August 31, 2018

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Re: Endangered Species Act Section 7(a)(2) Biological Opinion, and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response and Fish and Wildlife Coordination Act Recommendations for the NOAA Restoration Center's Program to Facilitate Implementation of Restoration Projects in the Central Valley of California

Dear Ms. Steger, Ms. Haley, and Mr. Ratcliff:

Thank you for your letter of November 7, 2017, and subsequent information received on April 20, 2018, where you requested initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the NOAA Restoration Center's Program to Facilitate Implementation of Restoration Projects in the Central Valley of California. Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1855(b)) for this action.

With this letter, we provide to you NMFS's biological opinion (opinion) and EFH consultation based on our review of the NOAA Restoration Center's Program to Facilitate Implementation of Restoration Projects in the Central Valley of California. The opinion analyzes the effects of the proposed action on endangered Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*), threatened Central Valley spring-run Chinook salmon (*O. tshawytscha*), threatened California Central Valley steelhead (*O. mykiss*), threatened Southern Distinct Population Segment (sDPS) of North American green sturgeon (*Acipenser medirostris*), and their designated critical habitats per section 7 of the ESA. From our analysis NMFS concludes that the proposed action is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, threatened Central Valley spring-run Chinook salmon, threatened California Central Valley steelhead, threatened sDPS green sturgeon, or adversely modify or destroy designated critical habitats for listed fish. Additionally, NMFS has included an incidental take statement with reasonable and prudent measures (RPM) and non-discretionary terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of these listed species.

NMFS also concludes that the proposed action will have minimal adverse effects to Pacific salmon, and Pacific groundfish EFH. Section 305(b)(2) of the MSA authorizes NMFS to provide EFH conservation recommendations to minimize adverse effects of an activity on EFH. Because any adverse effects to EFH will be minimal and multiple benefits to these habitats are expected, EFH conservation recommendations are not offered beyond what's been considered in the terms and conditions of the RPM. However, if the proposed action is modified in a manner that may adversely affect EFH, the NOAA Restoration Center, U.S. Army Corps of Engineers and U.S. Fish and Wildlife Service will need to reinitiate EFH consultation with NMFS.

Please contact Evan Sawyer (evan.sawyer@noaa.gov) at the NMFS California Central Valley Office, (916) 930-3656, if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

for Barry A. Thom
Regional Administrator

Enclosure

cc: To the File 51422-WCR2017-SA00386

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

NOAA Restoration Center's Program to Facilitate Implementation of Restoration Projects in the Central Valley of California

NMFS Consultation Number: WCR-2017-8532

Action Agencies: NOAA Restoration Center, the U.S. Army Corps of Engineers, and the United States Fish and Wildlife Service

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*)	Endangered	Yes	No	Yes	No
Central Valley spring-run Chinook salmon (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
California Central Valley steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Southern Distinct Population Segment (sDPS) of North American green sturgeon (*Acipenser medirostris*)	Threatened	Yes	No		

Affected Essential Fish Habitat and NMFS' Determinations:

Fishery Management Plan That Identifies EFH in the Project Area	Does Action Have an Adverse Effect on EFH?	Are EFH Conservation Recommendations Provided?
Pacific Coast Salmon	Yes	No
Pacific Ground Fish	Yes	No

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

Issued By: Maria Rea

for Barry A. Thom
Regional Administrator

Date: August 31, 2018

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1. INTRODUCTION

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

1.1 Background

This consultation concerns the effects of the proposed Program to Facilitate Implementation of Restoration Projects in the Central Valley of California (Program) and associated restoration activities on endangered Sacramento River (SR) winter-run Chinook salmon (*Oncorhynchus tshawytscha*), and threatened Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha)*, California Central Valley (CCV) steelhead Distinct Population Segment (DPS) (*O. mykiss*), southern DPS (sDPS) of North American green sturgeon (*Acipenser medirostris*), and their respective designated critical habitats.

Although many new and existing funding sources for restoration in the Central Valley possess a clear federal nexus, they tend to lack an efficient regulatory review process with the National Marine Fisheries Service (NMFS). Currently, each project must undergo Endangered Species Act (ESA) section 7 consultation, which can be time consuming and increase the costs of regulatory compliance. In a 2015 survey, Sustainable Conservation queried close to 20 restoration proponents throughout the Central Valley about the types and sizes of projects to be implemented as well as the future demand for permitting over the next decade (NMFS 2017). Restoration proponents showed unanimous support for a programmatic approach to permitting for restoration in the Central Valley, finding that the project-by-project ESA section 7 review slowed project implementation and increased agency staff workload and costs. Responding to the perceived need, the NOAA Restoration Center (RC), U.S. Army Corps of Engineers (Corps), and U.S. Fish and Wildlife Service (USFWS), with help from Sustainable Conservation, have developed a Program to facilitate the implementation of restoration projects in the Central Valley such that the potential adverse impacts from covered projects are minimized to the greatest extent practicable. The Program has been designed with the intent to avoid the majority of impacts to listed anadromous species and their habitats in the Central Valley and builds on similar programmatic consultations between NMFS, the NOAA RC and the Corps for restoration activities in the North, Central and Southern California coastal regions since 2006. With this Program and through this programmatic consultation with the NOAA RC, USFWS and the Corps, an accelerated review and implementation of fisheries habitat restoration activities for listed Central Valley anadromous species is expected.

NMFS prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with Section 7(b) of the ESA of 1973 (16 USC 1531 et seq.) and implementing regulations at 50 CFR 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR 600. Because the proposed action would modify a stream or other body of water, NMFS also provides recommendations and comments for the purpose of conserving fish and wildlife resources, and enabling the Federal agency to give equal consideration with other project purposes, as required under the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.).

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

1.2 Consultation History

The following list of meetings, correspondence and conversations catalogs the significant work that went into the development of the Program and this consultation.

- March 17, 2016, a phone conference was held between NMFS (Charlotte Ambrose) and Sustainable Conservation (a non-profit organization which provides technical assistance to the NOAA Restoration Center (RC) and NMFS to benefit restoration activities in California) to develop a strategy for a programmatic ESA section 7 consultation for restoration in the Central Valley, similar to previous consultations for restoration in the coastal areas of California, and to determine the appropriate staff from NOAA RC and NMFS who would attend subsequent coordination meetings.

- May 4, 2016, an initial meeting was held at the NMFS California Central Valley Office. Staff from NMFS, NOAA RC and Sustainable Conservation discussed the development of a programmatic consultation for restoration projects in the Central Valley, including the need for the Program due to increased restoration project funding from California Proposition 1 funding and other sources. A follow-up meeting with the Sacramento and San Joaquin Branch Chiefs of NMFS was planned to get further support for the proposal.

- June 8, 2016, a follow-up meeting with NMFS staff and Branch Chiefs, NOAA RC and Sustainable Conservation occurred at the NMFS office in Sacramento to further refine an outline (including project types) and timeline for the programmatic consultation. Sustainable Conservation agreed to conduct a Request for Proposals (RFP) process to hire a consulting firm to help with preparation of the Biological Assessment (BA).

- July 27, 2016, Maria Rea, Assistant Regional Administrator, submitted a letter to Sustainable Conservation to confirm NMFS' commitment to the programmatic consultation process for Central Valley restoration projects.

- August 11, 2016, a conference call with NMFS, NOAA RC and Sustainable Conservation was held to determine the lead staff from NMFS for the consultation process and the level of coordination between the NOAA RC, Sustainable Conservation and NMFS needed during the development of the BA. Discussed timing and process for engaging Corps as a co-lead federal agency.

- October 18, 2016, a Draft BA outline, list of project types for inclusion in the BA, and action area map was sent to NMFS via email for review and comment, prior to drafting the BA.

- November 9, 2016, a Draft General Conservation Measures Technical Memorandum was sent on behalf of NOAA RC and the Corps via email to NMFS staff for review and comment, prior to incorporating these measures into the Administrative Draft of the BA.

- May 26, 2017, Administrative Draft No. 1 of the BA was sent on behalf of NOAA RC via email to the Corps and NMFS staff for review and comment.

- July 18, 2017, a workshop was held at NOAA's offices in Sacramento with NOAA RC and NMFS to discuss NMFS' staff comments on Administrative Draft No. 1 of the BA.

- August 28, 2017, Administrative Draft No. 2 of the BA was sent on behalf of NOAA RC and the Corps via email to NMFS staff for review and comment.

- September 13, 2017, NMFS staff provided comments to NOAA RC and the Corps on Administrative Draft No.2.

- November 7, 2017, on behalf of NOAA RC and the Corps, Sustainable Conservation submitted to NMFS the *FINAL Biological Assessment and Essential Fish Habitat Assessment for a Program to Facilitate Implementation of Restoration Projects in the Central Valley of California*, and requested initiation of ESA consultation.

- December 7, 2017, Sustainable Conservation provided supplemental information to assist with the development of an ITS.

- December 22, 2017, NMFS sent a letter confirming an initial initiation date of November 8, 2017, for the consultation with the NOAA RC and the Corps on the NOAA RC's Program to Facilitate Implementation of Restoration Projects in the Central Valley of California.

- March 13, 2018, Sustainable Conservation, NOAA RC and the U.S. Fish and Wildlife Service (USFWS) discussed the inclusion of USFWS as a co-lead federal action agency to the Program.

- April 20, 2018, on behalf of NOAA RC, the Corps and USFWS, Sustainable Conservation submitted to NMFS a revised BA, which also included USFWS as a co-lead federal action agency, which restarted initiation of consultation.

- May 1, 2018, USFWS confirmed that they have requested to be added to the BA as a co-lead federal action agency.

1.3 Proposed Federal Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (50 CFR 402.02). The EFH definition of a federal action includes any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal Agency (50 CFR 600.910).

"Interrelated actions" are those that are part of a larger action and depend on the larger action for their justification. "Interdependent actions" are those that have no independent utility apart from the action under consideration (50 CFR 402.02). There are no interdependent or interrelated activities associated with the proposed action.

For the action described in this opinion, the NOAA RC, in coordination with the Corps (permitting) and USFWS (funding and technical assistance), proposes to fund, permit, or provide technical assistance for restoration projects within the California Central Valley so as to facilitate their implementation. General categories of restoration project types within the Program include: instream habitat improvements; barrier modification for fish passage improvement; bioengineering and riparian habitat restoration; upslope watershed restoration; removal of small dams (permanent, flashboard and other seasonal-type); fish screen installation, operation and maintenance; creation of off-channel/side-channel habitat; invasive plant removal and revegetation to improve fish and wildlife habitat; wetland and tidal marsh restoration and enhancement; piling and other instream structure removal to benefit water quality and habitat; and water conservation and streamflow augmentation projects to improve in-stream flow conditions for fish. The geographic extent of the NOAA RC's Program is described in Section 1.3.1, *Program Geographic Extent*, with the administration processes of the Program, including reporting requirements, described in Section 1.3.3, *Program Administration*. Limits to the scope of the Program are provided in Section 1.3.4, *Programmatic Sideboards and Other Program Requirements*. The majority of habitat restoration projects authorized by the Program will be designed and implemented following the techniques and minimization measures presented in agency manuals and technical guidance documents:

- CDFW Salmonid Stream Habitat Restoration Manual (Flosi et al. 2010),
- NMFS Guidelines for Salmonid Passage at Stream Crossings (NMFS 2001, hereafter referred to as NMFS' Crossing Guidelines), and
- NMFS Fish Screening Criteria for Anadromous Salmonids (NMFS 1997, hereafter referred to as NMFS' Screening Guidelines).

For the purposes of the Program, a "restoration project" is defined as one that will result in a net increase in aquatic or riparian resource functions and services. Although a project covered by the Program may include multiple benefits, such as flood management, groundwater recharge, recreation, or climate change adaptation, all covered projects must meet the criteria of a restoration project defined by the Program and must remain consistent (i.e., address a threat to recovery, help meet a recovery goal or objective, or is determined by NMFS to be beneficial to species) with NMFS' Recovery Plan for the Evolutionarily Significant Units of Sacramento

River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead (NMFS Central Valley Salmon and Steelhead Recovery Plan) (NMFS 2014). The *Number of Anticipated Projects* is described in Section 1.3.2, with project types described in greater detail in Section 1.3.5, *Covered Project Types and Prohibited Activities.* Avoidance and minimization measures necessary for all projects are described in Section 1.3.6, *Protection Measures.*

1.3.1 Program Geographic Extent

The NOAA RC and USFWS propose to fund or provide technical assistance on restoration projects, encompassing 19,872 square miles within portions of the following counties of the NOAA RC's Sacramento Field Office Region: Alameda, Amador, Butte, Calaveras, Colusa, Contra Costa, El Dorado, Fresno, Glenn, Madera, Mariposa, Merced, Nevada, Placer, Sacramento, San Benito, San Joaquin, Shasta, Solano, Stanislaus, Sutter, Tehama, Tuolumne, Yolo, and Yuba (Figure 1). Further, the Corps proposes to issue permits for the proposed projects under Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the Federal Water Pollution Control Act, as amended (Clean Water Act (CWA)), and Section 14 of the Rivers and Harbors Act of 1899 as codified in 33 United States Code (U.S.C.) 408 (e.g., Section 408), as necessary. The restoration projects will be within the NMFS's CCVO jurisdictional area and include projects permitted from 2018 into the future.

1.3.2 Number of Anticipated Projects

The number of restoration projects implemented on a yearly basis will be influenced by the available funding, interest from and capacity of restoration proponents to submit qualified project applications, project permitting and construction scheduling, and other factors. Potential funding sources for projects that adhere to the proposed Program are numerous, and include NOAA RC, USFWS, the California Department of Fish and Wildlife (CDFW), the Delta Conservancy, state and federal water contractors, U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS), U.S. Forest Service (USFS), National Parks Service (NPS), U.S. Bureau of Reclamation (BOR), U.S. Bureau of Land Management (BLM), California Wildlife Conservation Board (WCB), California Department of Water Resources (DWR), National Fish and Wildlife Foundation (NFWF), and others. Based on the expected funding and demand from restoration proponents throughout the Program geographic extent (Figure 1), the proposed action will include up to 60 active projects per year implemented under the Program. This means that at any given time during the life of the Program that only 60 concurrent projects will be covered.

The proposed action can be used to authorize activities by those who agree to carry out their projects in conformance with the standards specified in the sections below, including *Programmatic Sideboards and Other Program Requirements*, which includes management unit specific in-water work windows (Section 1.3.4), project-specific minimization measures (Section 1.3.5), general *Protection Measures* (Section 1.3.6), and *Monitoring and Reporting Requirements* (Section 1.3.7). Modified measures may be proposed by NOAA RC as appropriate, with the agreement of NMFS, based upon site-specific conditions or technological constraints or advances.

1.3.3 Program Administration

NOAA RC staff in Sacramento, California, will administer and oversee the Program to facilitate implementation of the restoration projects occurring in the jurisdiction of the CCVO of NMFS. This opinion analyzes the Program requirements, set forth by the NOAA RC, that will limit any adverse effects of individual projects as well as the cumulative adverse effects of multiple projects. These Program requirements are enacted and affected through the administration of the Program, such that all restoration projects included in the Program and analyzed by this opinion will be subject to the administration process, assessment and review described in this section.

Project Consideration

Project applications will come through the NOAA RC or USFWS for funding and/or technical assistance, or through the Corps at the time of application for a Clean Water Act Section 404 permit, a Rivers and Harbors Act Section 10 permit, and/or a Section 408 permit as codified in U.S.C. Section 408. Applications for proposed projects will be submitted by the project applicant for consideration in the Program. In addition, although a project may include multiple benefits, such as flood management, groundwater recharge or recreation, all projects in the Program must result in a net increase in aquatic or riparian resource functions and services and must be consistent with NMFS Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014) such that covered projects address an identified threat to recovery, help meet a recovery goal or objective, or is determined by NMFS to be beneficial to species.

The NOAA RC website will include contact information that enables project proponents to submit applications directly to NOAA RC staff. The NOAA RC website will also include a link to the Corps-Sacramento District Regulatory Division's website which provides instructions for the Corps' Section 404 application requirements. The NOAA RC will coordinate closely with the Corps to ensure that it has received the project application for the appropriate type of Section 404 permit.

Timeline

Project applications will be accepted throughout the year by the Corps, USFWS and/or NOAA RC and distributed to the Program's other cooperating agencies (Corps, NOAA RC, USFWS and NMFS) for review. As described below, Corps and USFWS staff may request assistance from NOAA RC for input on whether projects are consistent with the Program. As available, staff from the Corps, USFWS, NOAA RC, and NMFS will then bundle appropriate projects for review and processing approximately twice a year, in the early winter (December/January) and spring (March/April).

Submittal Requirements

The NOAA RC will take the lead for the Program and participate in the screening of individual projects under consideration for inclusion in the Program and will track implementation of individual projects. Project applicants seeking ESA coverage under the Program must submit sufficient information (described below) about their project to allow the NOAA RC, USFWS and the Corps to determine whether or not the project qualifies for coverage, regardless of whether the project applicants submit the information to the Corps (as part of their application for a Corps permit) or the NOAA RC or USFWS (for NOAA RC or USFWS-funded projects).

Applicants will be responsible for obtaining any other permits or authorizations from appropriate agencies before the start of project. Specifically, for those projects that may result in incidental take of the state-listed winter-run Chinook salmon or spring-run Chinook salmon (i.e., that will require dewatering and fish relocation activities in a stream historically known to support these two ESUs of Chinook salmon), the applicant will also need project approval from CDFW.

Applicants will provide the following information as part of a standard application:

a. Pre-project photo monitoring data (per CDFW photo-monitoring guidelines, and as described in Woodward and Hollar (2011));

b. Project description:

    i. Project problem statement;

    ii. Project goals and objectives;

    iii. Watershed context;

    iv. Description of the type of project and restoration techniques utilized (culvert replacement, instream habitat improvements, etc.);

    v. Project dimensions;

    vi. Description of construction activities anticipated (types of equipment, timing, staging areas or access roads required);

    vii. If dewatering of the work site will be necessary, description of temporary dewatering methods including qualified individual who will be onsite to capture and transport protect listed fish;

    viii. Construction start and end dates, including specific dates of in-water work and the application of work windows (described in Section 1.3.4 of this opinion);

    ix. Estimated number of creek crossings and type of vehicle;

    x. Materials to be used;

    xi. When vegetation will be affected as a result of the project (including removal and replacement), provide a visual assessment of dominant native shrubs and trees, approximate species diversity, and approximate acreage;

    xii. Description of existing site conditions and explanation of how proposed activities improve or maintain these conditions for listed species within expected natural variability;

xiii. Description of key habitat elements (i.e., temperature; type: pool, riffle, flatwater; estimate of instream shelter and shelter components; water depth; dominant substrate type, etc.) for listed species in project vicinity.

xiv. Description of applicable protection measures incorporated into the project.

xv. A proposed monitoring plan for the project describing how the applicant will ensure compliance with the applicable monitoring requirements described in the opinion (photo monitoring, revegetation, etc.), including the source of funding for implementation of the monitoring plan. Include adaptive management techniques or strategies that are informed by monitoring results.

xvi. A checklist for consistency the applicant must sign, verifying that the applicant agrees to adhere to all project conditions and protection measures during project design and implementation.

Proposed projects that deviate from the "covered" activities described in *Covered Project Types and Prohibited Activities* (Section 1.3.5) will require individual consultation. Modified protection measures (below) may be proposed by NOAA RC as appropriate, with the agreement of NMFS, based upon site-specific conditions or technological constraints or advances.

Initial Project Screening

The NOAA RC will be the first level of review in screening potential NOAA RC-funded projects, or projects requesting NOAA RC technical assistance, for authorization under the Program, including screening for more complex projects that might require additional oversight and engineering review by NMFS. The NOAA RC will determine whether a proposed project comports to the criteria of the Program. The Corps will be the first level of review in screening potential projects where the applicant applies for a Corps permit for authorization under the Program. The Corps will determine whether the proposed project comports to the criteria of the Program.

The Corps and USFWS will pre-screen projects where the applicant applied for a Corps permit for authorization under the Program or the USFWS provided funding or technical assistance. The Corps or USFWS will then turn the application over to the NOAA RC, which will use a pre-established checklist in the standard application form called the "Application for Inclusion in the NOAA RC Sacramento Office Programmatic Approach" to help determine if a proposed project fits within the parameters of the Program. Once projects have passed through the initial project screening, the NOAA RC will compile a report (project summary sheet/table) for the bundled projects to determine overall program consistency. Any projects that lack sufficient information to determine their appropriateness for inclusion in the Program are either further clarified or further developed by the project proponent and resubmitted.

Field visits by NOAA RC Staff and in some cases NMFS engineers may be necessary before projects are authorized for inclusion under the Program. Contact will typically be by email and will include the information submitted and the response of NMFS engineers. If the project is a stream crossing, dam removal, off-channel habitat feature, or any other fish passage project needing engineering review, NOAA RC will not move forward with the project until NMFS has finished engineering review or indicated via email that additional review is not needed. For other project types, those not requiring a NMFS engineering review, NOAA RC will assume a project qualifies for inclusion if it has not heard from NMFS staff within 2 weeks. The transmittal and response emails will be maintained in each project file by NOAA RC.

Authorization

With the RC's approval (and all other necessary approvals and permits obtained), authorized projects are then implemented by the applicants, incorporating all guidelines, protection measures, and additional required conditions (described in Section 1.3.6, *Protection Measures)*.

Post-Construction Implementation Monitoring

Qualifying applicants are required to conduct post-construction implementation monitoring and associated reporting requirements for their projects authorized under the Program. Monitoring and reporting will include photo-documentation consistent with the pre-construction monitoring requirements; post-construction plans on engineered projects (i.e., "as-built plans"); evidence of implementation of required protection measures; and information about the number (by species) of fish relocated and any fish mortality that resulted from the project. The applicant(s) will submit this information to the NOAA RC within 6 months of completion of construction for data assembly as described below. Applicants will be required to use the NOAA RC *Sacramento Office Programmatic Approach Post-Project Monitoring Form*, which will be given to applicants with approval of the project.

Project Tracking and Reporting

The NOAA RC, acting as lead agency, will provide tracking and oversight of all projects that are implemented under this Program. Specifically, the NOAA RC will annually prepare and submit to the NMFS California Central Valley Office a report of the previous year's restoration activities. The annual report will contain information about projects implemented during the previous construction season as well as projects implemented in prior years under the Program. This reporting will help ensure that the limits outlined by the Program, including the general minimization measures outlined in Section 1.3.6 *Protection Measures,* are adhered to, and that databases for tracking projects and any incidental take of listed species that occurs during implementation of projects authorized under the Program are accurate and available to all cooperating agencies.

The annual report will also include a summary of the specific type and location of each project, stratified by individual project and ESU and/or DPS. The report will include the following project-specific information:

- a summary detailing fish relocation activities, including the number and species of fish relocated and the number and species injured or killed;
- a map indicating the location of each project;

- the number and type of instream structures implemented within the stream channel;
- the size (acres, length, and depth) of off channel habitat features enhanced or created;
- the length of streambank (feet) stabilized or planted with riparian species;
- the number of culverts replaced or repaired, including the number of miles of restored access to unoccupied salmonid habitat;
- the size on number of dams removed, including the number of miles of restored access to unoccupied salmonid habitat;
- the distance (feet) of aquatic habitat disturbed at each project site; and
- the methods, results and discussion of effectiveness monitoring, as appropriate.

1.3.4 Programmatic Sideboards and Other Program Requirements

It is expected that projects covered under the Program will provide for habitat improvements that in turn will benefit listed species. As noted in Section 1.3.2, *Number of Anticipated Projects,* the Program will include no more than 60 concurrent projects in a year, as confirmed during the initial project screening and annual reporting. With the intent of the Program being to facilitate the implementation of restoration projects in the California Central Valley, the Program has been designed to minimize the potential for negative impacts to the greatest extent practicable. The primary way in which the Program minimizes the potential for short-term adverse impacts of individual projects, is with the use of sideboards that establish specific, measureable project criteria. Modified measures may be proposed by NOAA RC as appropriate, with the agreement of NMFS, based upon site-specific conditions or technological constraints or advances. Additionally, the NOAA RC, USFWS and the Corps have established Program limitations and requirements that must be implemented for any project to be included in the Program. The following sideboards, and other requirements proposed by the NOAA RC, USFWS and the Corps are necessary for projects to be included in the Program.

Limits to Location and Timing of Projects

In-water Work Windows

An important component of the Program, are the region specific proposed in-water work windows. The general construction season for upslope areas will be from June 1 to October 31 (outside of primary precipitation season) so as to avoid and/or minimize erosion potential. Because of the overlap in species and life-stage, it is not possible for a single in-water work window to avoid all life stages of each ESU and DPS throughout the entirety of the action area (see status of each species within the action area in Section 2.4, *Environmental Baseline*). Instead, the timing of the proposed in-water work windows for restoration projects included in the Program have been designed to avoid the most vulnerable of life stages for anadromous species, which is typically spawning and incubation due to the immobility and vulnerability of those life-stages (see Table 1-1 below). Many previous programs and agencies have taken an approach that limits in-water work windows to avoid the spawning and incubation life stages of salmonids, including the Upper Sacramento River Habitat Restoration biological opinion (NMFS 2015c), the Small Erosion Repair Program in the Sacramento River Basin (CDWR 2010), and the Oregon Department of Fish and Wildlife (2008). Using this approach as a guide, and with assistance from CDFW and NMFS CCVO staff, the proposed in-water work windows for this Program have been developed to avoid the "non-migratory" life stages of adult holding, spawning, and egg incubation while limiting exposure to less-vulnerable, "migratory" life stages of juvenile rearing and migration, and adult migration.

While the timing of non-migratory life stages between ESUs and DPSs have great overlap across the entire Central Valley, the spatial distributions for each ESU/DPS vary. Thus, the creation of spatially explicit in-water work windows at certain RKM points along a waterbody, provides the greatest flexibility in timing of construction activities. In order to achieve this, published observations of the downstream end of the spawning grounds for each ESU/DPS in the Sacramento and San Joaquin rivers and their tributaries are applied to inform the boundaries between different spatially explicit management units (MU). Finally, the life stage timing and spatial distributions of all the ESUs/DPSs were overlaid to determine work windows for four different management units across the Central Valley (see Table 1-1). A description of each management unit and corresponding work window is described and included in Table 1-1 with the locations of each management unit depicted in Figure 1-1. Any Program covered restoration, construction, fish relocation, and dewatering activities within any wetted or flowing stream channel will occur within these periods.

Extended or alternative work windows may be considered on an individual project basis if approval is applied for in advance and the applicant can demonstrate that measures implemented to avoid or minimize exposure would do so at a level commensurate with the standard in-water work windows. For example, in MU 2, instream work in these streams could start sooner than July 15 if NMFS determines that adult and juvenile CV spring-run Chinook salmon are no longer present based on environmental conditions and real time passage data, and instream work could be extended past October 31 if environmental conditions which would preclude juvenile CCV steelhead and CV spring-run Chinook salmon emigration or adult CCV steelhead immigration are expected to persist.

TABLE 1-1
IN-WATER WORK WINDOWS AND DESCRIPTIONS FOR FOUR CENTRAL VALLEY MANAGEMENT UNITS (MUS)

INCLUDES: WATERBODY, SPATIAL EXTENT - RIVER KILOMETERS (RKMS), ESU AND DPSS PRESENT, AND LIFE STAGES PRESENT.
W = WINTER-RUN, S = SPRING-RUN, ST = STEELHEAD, AND GS = GREEN STURGEON.

MU	Waterbody (s)	Applicable River Kilometer (RKM)	ESU/DPS	Non-Migratory	Migratory	Description	Work Window
1	Sacramento R.	>391[1]	W	✓	✓	Upper Sacramento R. with W and GS holding and spawning and S and ST spawning.	Oct 1 – Feb 15
			S	✓	✓		
			ST	✓	✓		
			GS	✓	✓		
2	Sacramento R.	>333, ≤391[2]	W		✓	Sacramento R. with GS holding and spawning, ST spawning, but below W and S spawning.	Jul 15 – Oct 31
			S		✓		
			ST	✓	✓		
			GS	✓	✓		
3	Sacramento R. Sacramento R. Tributaries w/o S San Joaquin R. San Joaquin R. Tributaries	≤333[2] Entire Length ≤414[5] Entire Length	W[3]		✓	Lower Sacramento R. and Sacramento R. tributaries with ST spawning, but no S spawning. San Joaquin R. mainstem with ST spawning, but below S spawning. San Joaquin R. tributaries with ST spawning, and potential S spawning.	Jun 1 – Oct 31
			S		✓		
			ST	✓	✓		
			GS[3]		✓		
4	San Joaquin River Sacramento R. Tributaries with S[4]	>414[5] Entire Length	W			Upper San Joaquin R. and Sacramento R. tributaries with S spawning.	Jul 15 – Sep 30
			S	✓	✓		
			ST	✓	✓		
			GS	✓	✓		

NOTES: [1]Kilam 2012, [2]Poytress et al. 2013, [3]Sacramento River Basin only, [4] Includes Mill Creek, Deer Creek, Butte Creek, Battle Creek, Clear Creek, Cottonwood Creek, Antelope Creek, Big Chico Creek, Yuba River, Feather River, [5] Gordon and Greimann 2014

Management Unit 1

Management Unit 1 encompasses the uppermost portion of the Sacramento River mainstem, which provides habitat for spawning for all listed ESUs. NOAA RC defined the downstream extent of MU 1 as 391 RKM, the most downstream observation of winter-run Chinook salmon spawning during historical aerial flight redd surveys (CDFW 2015). The in-water work window for MU 1 is defined as October 1 – February 15 to avoid the holding, spawning, and incubation life stages for winter-run Chinook salmon.

Management Unit 2

Management Unit 2 encompasses a portion of the Sacramento River mainstem that is downstream of winter-run and spring-run Chinook salmon spawning habitat, but provides spawning habitat for green sturgeon and steelhead. NOAA RC defined the downstream extent in the mainstem Sacramento River as 333 RKM, the most downstream observation of green sturgeon spawning during historical spawning surveys (Poytress et al. 2013). The majority of the dry summer and early fall period avoids the non-migratory life stages of steelhead and green sturgeon. However, the month of June was not included because green sturgeon can spawn through June (NMFS 2015b) . A summer/fall work window also avoids spawning of steelhead in the Sacramento River during winter and spring. Therefore, the in-water work window in MU 2 is defined as July 15 – October 31.

Management Unit 3

Management Unit 3 encompasses habitat in the lower Sacramento River (≤ 333 RKM), in Sacramento River tributaries without spring-run Chinook salmon spawning, in the San Joaquin River downstream of spring-run Chinook salmon spawning, and in San Joaquin river tributaries. The lower Sacramento River is downstream of green sturgeon and winter-run Chinook salmon spawning, with only steelhead spawning habitat present in this reach (occurring in the winter and spring months). The San Joaquin River tributaries support spawning habitat for steelhead in the winter and spring months, with reports (Franks 2014) that spring-running Chinook salmon may be present in the Stanislaus and Tuolumne rivers. Additionally, reintroduced spring-run Chinook salmon are expected to spawn in the uppermost reaches of the mainstem San Joaquin River below Friant Dam. Therefore, the in-water work window is defined to avoid late fall through spring months and is defined as June 1 – October 31. However, because of the possibility of spring-run Chinook salmon and early-arriving adult steelhead presence in San Joaquin River tributaries in October, in-water construction occurring during October in San Joaquin River tributaries must be approved by NMFS on a case-by-case basis. The project applicant must provide NMFS with detail on proposed species protection measures to minimize any potential incidental take.

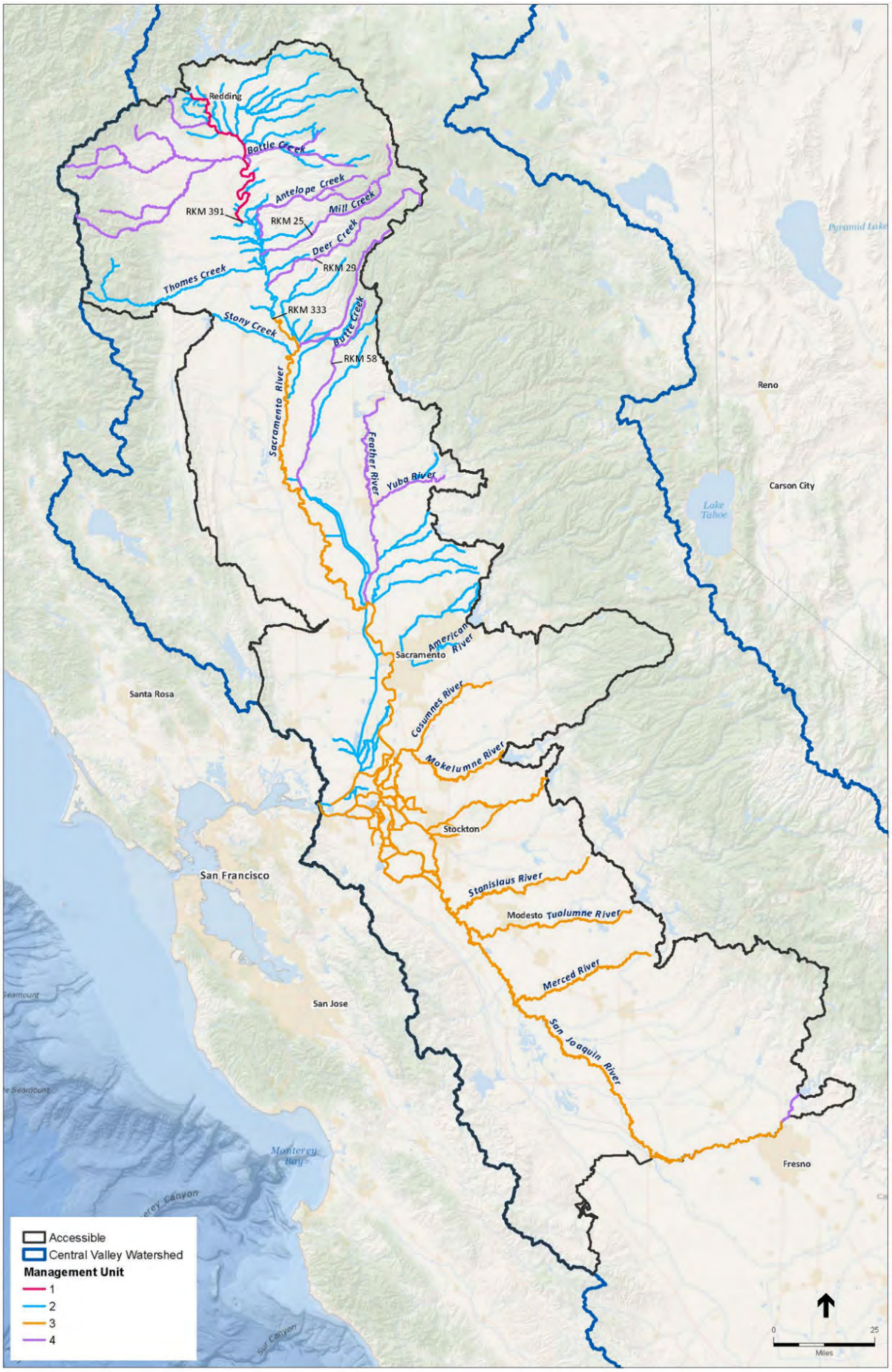


Figure 1-1: Central Valley Management Units (MUs)

Management Unit 4

Management Unit 4 encompasses spring-run Chinook salmon spawning and holding habitat in the San Joaquin River mainstem and Sacramento River tributaries that support spring-run Chinook salmon spawning. A spawning habitat suitability study conducted by Gordon and Greimann (2014) identified the first 16 KM downstream of Friant Dam on the San Joaquin River (> 414 RKM) as suitable habitat for spring-run Chinook salmon spawning, with suitable depths, velocities, and water temperatures present during the summer holding and fall spawning periods. The month of October is excluded from the in-water work window to avoid incubating spring-run Chinook salmon eggs. Therefore, the in-water work window is defined as July 15 – September 30.

Limits to Area of Disturbance for Individual Projects

Stream Dewatering During In-water Work Windows

In stream reaches where anadromous fish are expected to be present during construction, when practicable, complete dewatering of the channel cross-section will be avoided to maintain fish passage during construction. In cases where the entire channel cross-section must be dewatered, the maximum length of contiguous stream that can be dewatered is 1,000 feet (See also Sub-Section *General Measures to Limit the Effect of Dewatering Activities and Fish Relocation* in Section 1.3.6 for additional discussion on dewatering measures).

Upslope Disturbance (raw dirt, tree removal, canopy cover reduction)

The disturbance footprint for any individual project staging area may not exceed 0.50 acres.

Native trees with defects (snags, cavities, leaning toward stream channel, nests, late seral characteristics) >16 in. diameter at breast height (dbh) will be retained. All other trees >36 in. dbh will be retained. In limited cases, removal will be permitted if trees/snags are growing in culvert fill and need to be removed during a crossing upgrade or removal. The removal of exotic, invasive riparian vegetation in a stream prone to high water temperatures will be done in a manner to avoid creation of additional temperature loading to fish-bearing streams (See also Sub-Section *General Measures to Limit the Effect of Vegetation/Habitat Disturbance* in Section 1.3.6 for additional discussion on vegetation removal and replanting measures).

1.3.5 Covered Project Types and Prohibited Activities

All projects that are covered by the Program must meet the criteria of a restoration project where they must result in a net increase in aquatic or riparian resource functions and services and must remain consistent with NMFS Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014). Proposed restoration projects are categorized as follows: instream habitat improvements; barrier modification for fish passage improvement; bioengineering and riparian habitat restoration; upslope watershed restoration; removal of small dams (permanent, flashboard and other seasonal-type); fish screen installation, operation and maintenance; creation of off-channel/side-channel habitat; invasive plant removal and revegetation to improve fish and wildlife habitat; wetland and tidal marsh restoration and enhancement; piling and other instream structure removal to benefit water quality and habitat; and water conservation and streamflow augmentation projects to improve in-stream flow conditions for fish. Projects that will not be authorized under this program include water diversion or bypass flow requirements, flow operations from dams, large construction projects, or other projects requiring take authorization that are not specific to NOAA RC restoration proposed actions described below.

Covered Activities Described in the NMFS Guidelines and CDFW Manual

Habitat restoration projects authorized through the Program will be designed and implemented consistent with techniques and minimization measures presented in CDFW's *Manual*, Third Edition, Volume II with four chapters (Part IX: Fish Passage Evaluation at Stream Crossings, Part X: Upslope Assessment and Restoration Practices, Part XI: Riparian Habitat Restoration, and Part XII: Fish Passage Design and Implementation) added in 2003, 2004, and 2009, respectively (Flosi et al. 2010); *NMFS Crossing Guidelines* (NMFS 2001); and *NMFS Screening Guidelines* (NMFS 1997). The Program requires standard limits on the timing and area of disturbance for all projects in order to reduce the potential for ancillary effects to listed species and other riparian and aquatic species. These measures are described in the Section 1.3.4, *Programmatic Sideboards and Other Program Requirements*. Some activities also have additional project-specific minimization measures, which are listed following the description of the activity. Program activities (or project types) and related project specific minimization measures are described below.

Instream Habitat Structures and Improvements

Instream habitat structures and improvements are intended to provide predator escape and resting cover, increase spawning habitat, improve migration corridors, improve pool to riffle ratios, and add habitat complexity and diversity. Specific techniques for instream habitat improvement are described in the CDFW Salmonid Stream Habitat Restoration Manual, which includes, but is not limited to: (1) placement of cover structures (divide logs, engineered log jams, digger logs, spider logs; and log, root wad, and boulder combinations), boulder structures (boulder weirs, vortex boulder weirs, boulder clusters, and single and opposing boulder-wing-deflectors); (2) log structures (log weirs, upsurge weirs, single and opposing log-wing-deflectors, engineered log jams, and Hewitt ramps); (3) placement of imported spawning gravel; and (4) manipulation or removal of bank armoring or larger-caliber bed and bank material (i.e., revetment). Implementation of these types of projects may require the use of heavy equipment (e.g., self-propelled logging yarders, excavators, backhoes, helicopters).

Large woody material (LWM) may also be placed in the stream channel to enhance pool formation and increase stream channel complexity. Projects may include both anchored and unanchored logs, depending on site conditions and wood availability.

Creation of beaver habitat and installation of beaver dam analogue structures may also be done, including installation of in-stream structures to encourage or simulate beaver dam building.

Barrier Modification for Fish Passage Improvement

Barrier modification projects are intended to improve anadromous fish passage by (1) providing access to upstream habitat, (2) improving access to habitat, and (3) increasing the duration of accessibility (both within and between years). Projects may include those that improve fish passage through existing culverts, bridges, and paved and unpaved fords through replacement, removal, or retrofitting. In particular, these practices may include the use of gradient control weirs upstream or downstream of barriers to control water velocity, water surface elevation, or provide sufficient pool habitat to facilitate jumps, or interior baffles or weirs to mediate velocity and the increased water depth. Weirs may also be used to improve passage in flood control channels (particularly concrete lined channels). The Program also includes logjam modifications to facilitate juvenile and adult fish passage as well as construction, improvement and maintenance of fish ladders/fishways. The Program only applies to the fish passage facility/component of the weir, rather than the entire operation of the weir. Implementing these types of projects may require the use of heavy equipment (e.g., self-propelled logging yarders, mechanical excavators, backhoes); however, hand labor will be used when possible.

Bioengineering and Riparian Habitat Restoration

These projects are intended to improve salmonid habitat through increased stream shading intended to lower stream temperatures, increased future recruitment of LWM to streams, and increased bank stability and invertebrate production. Riparian habitat restoration projects will increase the number of plants and plant groupings, and will include the following types of projects: natural regeneration, livestock exclusionary fencing, bioengineering, and revegetation. Part XI of the CDFW Manual, Riparian Habitat Restoration, contains examples of these techniques.

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. The proposed activities are expected to reduce stream sedimentation from bank erosion by stabilizing stream banks with appropriate site-specific techniques including: boulder-streambank stabilization structures, log-streambank stabilization structures, tree revetment, native plant material revetment, willow wall revetment, willow siltation baffles, brush mattresses, checkdams, brush checkdams, water bars, and exclusionary fencing. Guidelines for stream bank stabilization techniques are described in Part VII of the CDFW Manual, Project Implementation. These types of projects usually require the use of heavy equipment (e.g., self-propelled logging yarders, mechanical excavators, backhoes).

Per Section 1.3.6, *Protection Measures*, when bioengineering bank stabilization options are not feasible due to site conditions, the amount of rock and other structural materials used for stream bank protection shall be limited to the minimum needed for scour protection.

Upslope Watershed Restoration

Upslope watershed restoration projects are intended to reduce excessive delivery of sediment to anadromous salmonid streams. 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. Road-related upslope watershed restoration projects will include: road decommissioning, upgrading, and storm proofing.

Implementation of these types of projects may require the use of heavy equipment (e.g., self-propelled logging yarders, mechanical excavators, backhoes); however, hand labor will be used when possible.

Removal of Small Dams (permanent, flashboard and other seasonal-type)

Small dam removal is conducted to restore fisheries access to historic habitat for spawning and rearing and to improve long-term habitat quality and proper stream geomorphology. Types of eligible small dams include permanent, flashboard, debris basin, earthen and seasonal-type dams with the characteristics listed below. Although the CDFW Manual does not cover the removal of small dams, guidelines and minimization measures have been developed in this Program. Implementing these types of projects may require the use of heavy equipment (e.g., self-propelled logging yarders, mechanical excavators, backhoes, etc.). Where appropriate, dams removed by the use of explosives are covered under this programmatic consultation provided that the appropriate sideboards (listed below) are applied.

Small dams included in the Program are those considered by the California Division of Dam Safety as non-jurisdictional sized dams, which are smaller in height or impounding capacity than those defined by the California Water Code where:

> *"Dam" means any artificial barrier, together with appurtenant works, which does or may impound or divert water, and which either (a) is or will be 25 feet or more in height from the natural bed of the stream or watercourse at the downstream toe of the barrier, as determined by the department, or from the lowest elevation of the outside limit of the barrier, as determined by the department, if it is not across a stream channel or watercourse, to the maximum possible water storage elevation or (b) has or will have an impounding capacity of 50 acre-feet or more* (California Water Code sec. 6002).

For the purpose of this Program, "small dams" are those dams that are either (a) less than 25 feet in height from the natural bed of the stream or (b) designed to have an impounding capacity of less than 50 acre-feet.

In addition, this Program will only include dam removal that will form a channel at natural grade and shape upstream of the dam, naturally or with excavation, in order to minimize negative effects on downstream habitat. Small dam removal projects will (1) have a relatively small volume of sediment available for release (relevant to the size of the stream channel, that when released by storm flows, will have minimal effects on downstream habitat as verified by a qualified engineer and reviewed by a NMFS engineer prior to project initiation) that, when released by storm flows, will have minimal effects on downstream habitat or (2) will be designed to remove sediment trapped by the dam down to the elevation of the target thalweg including design channel and floodplain dimensions. This can be accomplished by estimating the natural thalweg using an adequate longitudinal profile (CDFW Manual Part XII Fish Passage Design and Implementation) and designing a new, natural shaped channel that provides the same hydraulic conditions and habitat for listed fish that is provided by the natural channel and has the capacity to accommodate low flows. The channel itself will have a larger capacity to handle flood flows.

One of two methods will be used to restore the channel in a small dam removal project: 1) natural channel evolution or 2) "stream simulation" design. The conditions under which each of these methods may be used are as follows:

Natural channel evolution: The natural channel evolution approach to restoring a channel bed consists 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) risks are minimal (or all 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 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 habit; and 3) when possible, project implementation should follow procedures that have been documented as having been successfully performed elsewhere under similar circumstances. Notching the dam in increments after periodic storm events in order to reduce the amount of sediment being released during any individual storm event shall not be permitted unless project funding is sufficient 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 will be physically removed and the channel through the excavated reach will be designed using stream simulation. Stream simulation designs shall be conducted in accordance with known stream restoration and fish passage guidance documents. This specifically includes: (1) the identification of a suitable reference reach; (2) quantification of the average cross-sectional shape, bank full 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 (3) reproducing the geomorphic features found within the reference reach in the project reach.

Data Requirements and Analysis:

- A longitudinal profile of the stream channel thalweg for at least a distance equal to 20 channel widths upstream and downstream of the structure and long enough to establish the natural channel grade, whichever is farther, shall be used to determine the potential for channel degradation (as described in the CDFW Manual).

- A minimum of five cross-sectional profiles: one downstream of the structure, three roughly evenly spaced through the reservoir area upstream of the structure, and one upstream of the reservoir area outside of the influence of the structure to characterize the channel morphology and quantify the stored sediment.

- Sediment characterization within the reservoir and within a reference reach of a similar channel to determine the proportion of coarse sediment (>2mm) in the reservoir area and target sediment composition.

- A habitat typing survey (CDFW Manual Part III, Habitat Inventory Methods) that maps and quantifies all downstream spawning areas that may be affected by sediment released by removal of the water control structure.

Project-specific Minimization Measures

Use of Explosives for Small Dam Removal: Any use of explosives for small dam removal must be justified due to site-specific conditions including equipment access difficulties. Explosives use must be conducted in dry or dewatered conditions and potential harm to salmon and steelhead from the explosives blast and pressure waves must be analyzed.

Turbidity Measures: To minimize effects to aquatic species, stream diversions shall be in place for the shortest duration necessary to complete in-stream project activities.

Projects may be deemed ineligible for the Program if (1) sediments stored behind dam have a reasonable potential to contain environmental contaminants [dioxins, chlorinated pesticides, polychlorinated biphenyls, or mercury] beyond the freshwater probable effect levels summarized in the NOAA Screening Quick Reference Table guidelines or (2) the risk of significant loss or degradation of downstream spawning or rearing areas by sediment deposition is considered to be such that the project requires more detailed analysis. Sites shall be considered to have a reasonable potential to contain contaminants of concern if they are downstream of historical contamination sources such as lumber or paper mills, industrial sites, or intensive agricultural production going back several decades (i.e., since chlorinated pesticides were legal to purchase and use). Preliminary sediment sampling is advisable in these areas to determine if a project would be eligible for the Program.

See additional discussion of "*More Complex Projects Requiring Additional Oversight and Engineering Review by NMFS*" in this section.

Fish Screens

This category of project includes the installation, operation, and maintenance of the types of fish screens described below, provided they meet current NMFS (1997) fish screening criteria and are consistent with the NMFS' (2011c) anadromous salmonid passage facility design. Installing a fish screen usually includes site excavation, forming and pouring a concrete foundation and walls, pile driving, excavation and installation of a fish bypass pipe or channel, and installation of the fish screen structure. Heavy equipment is typically used for excavation of the screen site and bypass.

See additional discussion for, "*More Complex Projects Requiring Additional Oversight and Engineering Review by NMFS*" in this section.

If the fish screen is placed within or near flood prone areas, typically rock or other armoring is installed to protect the screen. Fish screen types include:

- Self-cleaning screens, including flat plate self-cleaning screens, and other self-cleaning designs, including, but not limited to, rotary drum screens and cone screens, with a variety of cleaning mechanisms, consistent with NMFS guidelines (NMFS 1997, 2011c).
- Non-self-cleaning screens, including tubular, box, and other screen designs consistent with NMFS screening criteria (NMFS 1997, 2011c).

Project-specific Minimization Measures

Diversion of Flows: All flows will be diverted around work areas as described in the Requirements for Fish Relocation and Dewatering Activities.

Fish Relocation: Fish removal may be required at project sites and best management practices will be implemented as described in the Requirements for Fish Relocation and Dewatering Activities.

Disturbance of Riparian Vegetation: Riparian disturbance will be minimized as described in the Measures to Minimize Loss or Disturbance of Riparian Vegetation.

Covered Activities Not Described in the NMFS Guidelines and CDFW Manual

Creation of Off-channel/Side Channel Habitat

The creation of off-channel or side channel habitat is not included in the CDFW Manual, however, guidelines and minimization measures have been developed for the Program. Types of side channel or off-channel restoration projects that will be eligible for the Program are:

- gravel augmentation occurring as part of the creation of side channel or off-channel habitats;
- connection of abandoned side channel or pond habitats to restore fish access;
- connection of adjacent ponds, remnants from aggregate excavation;
- connection of oxbow lakes on floodplains that have been isolated from the meandering channel by river management schemes, or channel incision;
- creation of side channel or off-channel habitat with self-sustaining channels; and
- improvement of hydrologic connection between floodplains and main channels;
- floodplain restoration to improve wildlife habitat and water quality.

Projects that involve the installation of a flashboard dam, head gate or other mechanical structure are not part of the Program. Managed surrogate floodplain and managed returned flows that require manual ingress and egress of juvenile salmonids are also not included under this Program and will be reviewed under an individual project section 7 consultation. Off-channel ponds constructed under this Program will not be used as a point of water diversion. Use of logs or boulders as stationary water level control structures will be allowed.

Restoration projects in this category may include removal or breaching of levees and dikes, channel and pond excavation, creating temporary access roads, constructing wood or rock tailwater control structures, and construction of LWM habitat features. Projects may also include installation, replacement, and relocation of irrigation canals, structures, utilities and appurtenant structures; and reconstruction of existing stream channels through excavation and structure placement or relocation. Implementation of these types of projects may require the use of heavy equipment (e.g., self-propelled logging yarders, mechanical excavators, backhoes, front-loaders, etc.).

Information regarding consideration of water supply (channel flow/overland flow/groundwater), water quality, and reliability; risk of channel change or dissociation that could lead to stranding; as well as channel and hydraulic grade will be provided in the project proposal. If a proposed project requires extensive additional engineering analysis, the project should follow the criteria found in the sub-section "*More Complex Projects Requiring Additional Oversight and Engineering Review by NMFS*" and may be considered for individual section 7 consultation.

Invasive Plant Removal and Revegetation to Improve Fish and Wildlife Habitat

Invasive plant removal and revegetation to improve fish and wildlife habitat may include the employment of manual, mechanical, biological and chemical methods to remove invasive non-native plants. All of the available methods have inherent advantages and disadvantages that can also be specific to the project location and the invasive species being removed. Madsen (2000) identifies the most common plant removal techniques and best management practices for each. During NMFS project review the most appropriate techniques will be considered given the project and species limitations. These efforts may be stand-alone or associated with planting of native riparian vegetation. Predator control is not included under the proposed action.

Project-specific Minimization Measures

The following measures regarding insecticide, herbicide, and other chemical application shall be adhered to as explained below and in sub-section "*Vegetation and Habitat Disturbance*" found in Section 1.3.6, *Protection Measures*.

- Application of chemicals must be done by qualified individuals and application must be designed to reduce impact to non-target species and surface waters.
- To the greatest extent feasible, herbicides will be applied directly to target species by backpack sprayer or hand application to minimize exposure to non-target species and reduce the risk of herbicide drift.
    - For broadcast application, a minimum of 100-foot buffer from the water's edge shall be employed.

    - For backpack spraying and bottle spray application, a minimum 15-foot buffer from the water's edge shall be employed.
    - Within 15 feet of the water's edge, only hand application (i.e., wicking, wiping, and injections) shall be used.

- Chemical use is restricted in accordance with approved application methods and best management practices 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 and be applied by a licensed applicator under all necessary state and local permits.

- Only chemicals approved for aquatic use will be used on the waterside of a levee.

- A nontoxic biodegradable dye/spray pattern indicator shall be added to the spray tank whenever possible, as visual aide to track application.

- The preferred method of application is on the root base of individual plants targeted for irradiation rather than blanket application over a large area, and application well before the seeding season of a noxious plant begins.

- Methods that do not require surfactants/adjuvants will be used whenever possible. In situations where surfactants are necessary, products used will be limited to those determined to be the least toxic to aquatic and marine/estuarine organisms.

- Herbicides shall only be applied by persons who have all certificates and licenses required by the relevant state and/or county. Licensed Applicators shall follow all federal, state and local regulations regarding herbicide use.

- Any herbicides will be transported to and from the worksite in tightly sealed waterproof carrying containers. The licensed Applicator shall carry a kit for emergency spills. Should a spill occur, people will be kept away from affected areas until the clean-up is complete.

- Herbicide applications shall be timed to maximize favorable weather conditions. To avoid herbicide drift and potential non target impacts, spray herbicides shall be applied when wind speeds are less than 10 mph or according to the label directions, whichever is more restrictive/requires a lower wind speed for application. The length of time required between herbicide application and rainfall, referred to as the rainfast period, varies for different herbicides. The licensed Applicator shall follow recommendations for restrictions related to rainfall or ground moisture for each herbicide used. In addition, herbicides shall not be applied when rain is forecasted to occur within 24 hours or during a rain event.

- The licensed Applicator shall keep a record of all plants/areas treated, amounts and types of herbicide used, and dates of application. Site conditions to be considered include accessibility, proximity to open water, depth to groundwater, the presence of rare species and other conservation targets, and the site's sensitivity to trampling that could occur when the herbicide is being applied.

In addition, the licensed Applicator shall also adhere to conservation measures for herbicide application described below (Tu et al. 2001):

1. All application equipment must be calibrated.

2. Field scouting and monitoring must be done before herbicide application.

3. Herbicide-free buffers around sensitive areas shall be created, where feasible

4. The lowest legal effective application rate of herbicide shall be used.

5. Vegetative buffers shall be used to minimize offsite movement of herbicides.

Wetland and Tidal Marsh Restoration and Enhancement

Wetland and tidal marsh restoration and enhancement may include, but are not limited to: excavation, transfer, or import and contouring of sediment to sites to achieve appropriate tidal elevations that replicate natural inundation cycles. Projects may include levee, berm and dike setbacks and removal to activate disconnected surfaces and restoration of tidal flows onto marsh plains and mud flats. The project type may also include reconnecting or creating tidal and fluvial channels, removal of existing drainage structures, such as drain tiles, constructing small nesting islands; constructing open water areas; construct oyster habitat over unvegetated bottom in tidal waters and plowing or discing for seed bed preparation and the planting of appropriate wetland species. Freshwater marsh restoration will generally consist of actions involving grading (e.g., creating depressions, berms, and drainage features) to create topography that supports native marsh plants (planted or recruited naturally), provides habitat elements for target species, and allows fish and other aquatic species to exit if waters recede.

Riparian Habitat Restoration and Enhancement

Riparian uplands will be planted with native woody and herbaceous species such that it creates an ecosystem function equal to or greater than pre-project conditions. Following initial control of weeds, a seed mix of native riparian grasses, sedges, and wildflowers may be applied in areas at appropriate elevations. If soils are very compacted or low in nutrients, the soils may be amended with slow release fertilizer prior to planting. Cuttings from native riparian trees and shrubs could be collected from the project vicinity and installed in the riparian zones. Riparian trees and shrubs could also be field grown and transplanted in the winter as bare root stock, as appropriate.

Weed control may be implemented at least one year before planting and could include application of herbicides, mechanical disking, and mowing, as appropriate. Preference would be given to disking or mowing, but if slopes are too steep (e.g., greater than 3:1), or if existing planted vegetation is in the way, herbicide application may be necessary. For each new or replaced riparian planting, the plantings will be irrigated for up to three years during the dry part of the year, as necessary based on the plant type and local conditions, with a drip irrigation system connected to existing irrigation pumps retrofitted with fish screens. Maintenance of riparian plantings will use adaptive management practices to help ensure that the success of re-planting will be at a level expected to maintain or enhance ecosystem functions.

Piling and Other Instream and Bank Structure Removal to Benefit Water Quality and Habitat

Legacy piling and other instream and bank structure removal to benefit water quality and habitat may be implemented utilizing mechanical techniques, including the use of cranes, excavators and vibratory pile drivers (for purposes of removal).

Water Conservation and Streamflow Augmentation Projects to Improve In-stream Flow Conditions for Fish

Water conservation and streamflow augmentation projects to improve instream flow conditions for fish includes streamflow augmentation, developing off-stream water storage, creating tailwater collection ponds, and installing water storage tanks and associated piping.

Developing Alternative Stockwater Supply: Many riparian fencing projects will require the development of off-channel watering areas for livestock. These are often ponds that have been excavated and are filled either by rainwater, overland flow, surface diversions or groundwater (either through water table interception or pumping). The Program also covers water lines, watering troughs, and piping used to provide groundwater to livestock.

Project-specific Criteria for Eligibility

Only projects with existing diversions compliant with water laws will be considered. In addition, storage reservoirs will have an impounding capacity not to exceed 10 acre-feet per year. Flow measuring device installation and maintenance may be required for purposes of accurately measuring and managing pumping rate or bypass conditions set forth in the water right or special use permit.

Project-specific Minimization Measures

- All pump intakes will be screened in accordance with NMFS (1997) "Fish Screening Criteria for Salmonids" and guidance on "Anadromous Salmonid Passage Facility Design" (NMFS 2011c).

- Stockwater ponds and wells will be located at least 100 feet from the edge of the active channel and are not likely to cause stranding of juvenile salmonids during flood events.

Livestock Fencing, Stream Crossings and Off-Channel Watering to Improve In-stream Water Quality and Flow Conditions: Livestock fencing, stream crossings and off-channel watering to improve in-stream water quality and flow conditions may be implemented in areas where livestock have access to streams and rivers.

Tailwater Collection Ponds: 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 pond, can be reused for future irrigation purposes, therefore reducing the need for additional stream diversions.

Project-specific Minimization Measures

- Tailwater collection ponds that do not incorporate return channels to the creek will be located at least 100 feet from the edge of the active channel and are not likely to cause stranding of juvenile salmonids during flood events.

Water Storage Tanks and Off-stream Ponds Water storage tanks and ponds could either be filled through rainwater catchment or by surface or groundwater flow. Under this Program, all water storage tank and pond projects will be required to enter into a forbearance agreement for at least 10 years, which will provide temporal and quantitative assurances for pumping activities that result in less water withdrawal during summer low flow period. The low flow threshold proposed in the application will be based upon the season, local conditions, and existing studies if available. Water storage capacity for the water diversion forbearance period must be of sufficient capacity to provide for all water needs during that time period. For example, if the no-pump period is 105 days (August to November), the diverters must have enough storage to cover any domestic, irrigation, or livestock needs during that time.

Project-specific Minimization Measures

- All pump intakes will be screened in accordance with NMFS screening and passage criteria (NMFS 1997; 2011c).

- Water conservation projects that include water storage tanks or ponds with a Forbearance Agreement for the purpose of storing winter and early spring water for summer and fall use, require registration of water use pursuant to California Water Code § 1228.3, and require consultation with CDFW. Diversions to fill storage facilities during the winter and spring months shall be made pursuant to a Small Domestic Use Appropriation (SDU) filed with the State Water Resources Control Board (SWRCB).

Piping Ditches: Many diversions that flow from the point of diversion to the point of use through ditches are subject to leaks and evaporation. Piping projects consist of constructing a pipe to transport irrigation water instead of a ditch, thereby reducing evaporation and absorption. Water saved by these projects will remain in the stream for anadromous salmonid benefits. Applicants must demonstrate that they intend to dedicate water for instream beneficial use by filing a Petition for Instream Flow Dedication (California Water Code § 1707, 1991) and make progress towards instream dedication.

Project-specific Minimization Measures

- Only water conservation piping projects that result in a decrease in the diversion rate with a permitted instream dedication of the water saved are included in the Program.

- Landowners will enter an agreement with NOAA RC, USFWS or the Corps stating that they will maintain the pipe for at least 10 years.

More Complex Projects Requiring Additional Oversight and Engineering Review by NMFS

More complex project types covered by the Program will require a higher level of oversight (those with complex designs requiring engineering review) and review by NMFS regulatory agency staff and agency engineers. These project types will include: culvert retrofit and replacement projects; construction of new fish ladders/fish ways; retrofitting of older fish ladders/fishways; permanent removal of flash board dam abutments and sills; installation of fish screens; and placement of weirs in concrete lined channels.

Specific requirements associated with these more complex project types include the following:

- For stream crossing projects, the project must allow passage of the life stages and covered salmonid species historically passing there. Retrofit culverts shall meet the fish passage criteria for the passage needs of the listed species and life stages historically passing through the site prior to the existence of the road crossing according to NMFS Crossing Guidelines and CDFW stream crossing criteria (see Part XII of the CDFW Manual).

- All designs for fish ladders/fish ways and culvert replacement or modification projects must be reviewed and authorized by a NMFS (or CDFW) fish passage specialist prior to commencement of work.

- All designs for fish ladders/fish ways and culvert replacement or modification designs must be designed and stamped by an engineer registered in the State of California.

- All designs for fish ladders/fish ways shall follow the NMFS Anadromous Salmonid Passage Facility Design manual's fish ladder design guidelines (NMFS 2011c) including any subsequent updates to the manual.

- New ladders/fishways shall be constructed to provide passage conditions suitable for year round bidirectional adult and juvenile salmonid movement.

- New ladders will have a maximum vertical jump of six inches, unless NMFS guidelines are changed.

- Flow patterns in new ladders must be stable, with no water surges.

- Energy dissipation in new ladders should be complete in a step-and-pool fishway, with no carryover from pool to pool.

- Sediment composition and quantity, and effects of sediment transport must be evaluated by a qualified geomorphologist for all dam removal projects.

Prohibited Activities

The following activities are not within the scope of the NOAA RC, USFWS and Corps Restoration Program, and are not analyzed in this opinion. As such, the following projects, or projects with the following elements, will require separate consultation with NMFS:

- use of gabion baskets;
- use of cylindrical riprap (e.g., Aqualogs);
- use of undersized riprap (rock that will not remain in place during a 100-year flow event);
- permanent dams or construction of concrete lined channels of any sort;
- use of chemically-treated timbers used for grade or channel stabilization structures, bulkheads or other instream structures;
- activities substantially disrupting the movement of those species of aquatic life indigenous to the waterbody, including those species that normally migrate through the project footprint; (e.g. habitat projects without geomorphic and hydraulic modeling showing a low potential to divert aquatic life and/or leave aquatic life stranded);
- projects that would completely eliminate a riffle, pool, or riffle/pool complex[1];
- water diversions, not explicitly identified in this Section under "*Water Conservation and Streamflow Augmentation Project to Improve In-stream Flow Conditions for Fish*," to temporarily dewater a restoration project construction site, or small diversions used for the sole purpose of the drip-irrigation of restoration plantings;
- off-channel/side-channel habitat projects that require the installation of a flashboard dam, head gate or other mechanical structures;
- projects that have the potential to create a passage barrier for anadromous fish species as determined by NMFS Fish Passage guidelines (including any associated maintenance activities, or lack thereof);
- rock bank protection, other than the minimum amount needed as determined by NOAA RC in coordination with NMFS;
- installation of infiltration galleries;
- predator control projects; and

[1] There may be some instances where a riffle/pool complex is affected/modified by a restoration project (i.e., a culvert removal that affects an existing pool), these types of projects would be allowed under the Program.

- managed surrogate floodplain and managed returned flows that require manual ingress and egress of juvenile salmonids.

1.3.6 Protection Measures

In addition to the minimization measures included as part of individual projects, a number of protection measures have been incorporated into the Program such that these general conservation measures apply to all projects supported by the Program. The purpose of the protection measures is to incorporate design refinements and best practices into a project 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 a given project. The rationale behind including these environmental 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 all restoration projects authorized under the Program, during the administration process (Section 1.3.3) specific measures may be altered, added or removed on an individual project basis based upon site-specific conditions or technological constraints or advances, and with the approval of NMFS.

General Conservation Measures

- Work shall not begin until (a) the NOAA RC has notified the applicant that the requirements of the ESA have been satisfied and that the activity is authorized, and (b) all other necessary permits and authorizations are finalized. Prior to construction, any contractor shall be provided with the specific protective measures to follow during implementation of the project. In addition, a qualified professional, approved by NMFS, shall provide the construction crew with information on the protected species potentially found in the project vicinity, the protection afforded the species by the ESA and California Endangered Species Act, and guidance on those specific protection measures that must be implemented as part of the project.

- Water (e.g., trucks, portable pumps with hoses) shall be used to control fugitive dust during temporary access road construction with appropriate plans detailing watering amounts and schedule to produce sufficient dust control, waste-water run-off management measures, and planned water sources, as necessary.

- All materials placed in 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.

- No materials shall be placed in any location or in any manner that would impair the flow of surface water into or out of any wetland area.

- Gravel, either obtained onsite or from a commercial source, will be appropriately screened (by size separator) prior to being placed in the river to avoid introduction of fine material. On-site gravels will be screened and sorted; gravels imported from a commercial source will be clean-washed and of appropriate size. Placement will be overseen by a qualified individual and implementation timing will be determined based on the least amount of overlap, or impact on, all sensitive resources that may be affected and the timing of their use of the receiving area.

- 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, 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 diversions in compliance with NMFS salmonid-screening specifications.

- All refuse, debris, unused materials, equipment, and supplies that cannot reasonably be secured shall be removed daily from the project work area and deposited at an appropriate disposal or storage site. All trash and construction debris shall be removed from the work area immediately upon project completion.

- During project activities all trash, especially food-related refuse, that may attract potential predators of salmonids will be properly contained, removed from the work site, and disposed of daily.

- Construction materials such as portable equipment, vehicles, and supplies, including chemicals, shall be stored at designated construction staging areas and 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 appropriate and practical, barges shall be used to stage equipment and construct the project to reduce noise and traffic disturbances and effects to terrestrial vegetation. When barge use is not practical, construction equipment and plant materials shall be staged in designated terrestrial areas adjacent to the project sites. Existing staging sites, maintenance toe roads, and crown roads shall be used to the maximum extent possible for project staging and access to avoid affecting previously undisturbed areas.

General Measures to Protect Water Quality and Limit Hazardous Materials

- Poured concrete shall be excluded from the wetted channel for a period of 30 days after it is poured. During that time, runoff from the concrete shall not be allowed to enter a live stream. Commercial sealants may be applied to the poured concrete surface where difficulty in excluding water flow for the 30-day period may occur. If sealant is used, water shall be excluded from the site until the sealant is dry and fully cured according to the manufacturer's specifications.

- Debris, soil, silt, excessive bark, rubbish, creosote-treated wood, raw cement/concrete or washings thereof, asphalt, paint or other coating material, oil or other petroleum products, or any other substances which could be hazardous to aquatic life, resulting from project related activities, shall be prevented from contaminating the soil or entering federal and state jurisdictional waters. Any of these materials, placed within or where they may enter a stream or lake, by the applicant or any party working under contract, or with permission of the applicant, shall be removed immediately.

- All mechanized equipment working in the stream channel or within 25 feet of a wetted channel shall have a double (i.e., primary and secondary) containment system for diesel and oil fluids. Hydraulic fluids in mechanical equipment working within the stream channel shall not contain organophosphate esters. Vegetable-based hydraulic fluids are preferred.

- The use or storage of petroleum-powered equipment shall be accomplished in a manner to prevent the potential release of petroleum materials into waters of the state.

- Areas for fuel storage, refueling, and servicing of construction equipment must be located in an upland location.

- Prior to use, all equipment shall be cleaned to remove external oil, grease, dirt, or mud. Wash sites must be located in upland locations so wash water does not flow into a stream channel or adjacent wetlands. All construction equipment must be in good working condition, showing no signs of fuel or oil leaks. Prior to construction, all mechanical equipment shall be thoroughly inspected and evaluated for the potential of fluid leakage. All mechanical equipment shall be inspected on a daily basis to ensure there are no motor oil, transmission fluid, hydraulic fluid, or coolant leaks. All leaks shall be repaired in the equipment staging area or other suitable location prior to resumption of construction activity. Equipment stored for a lengthy period of time (more than one week on site) shall have drip and leak pans placed underneath potential leak areas to contain accidental drips.

- Oil absorbent and spill containment materials shall be located on site when mechanical equipment is in operation within 100 feet of the proposed watercourse crossings. If a spill occurs, no additional work shall commence in-channel until (1) the mechanical equipment is inspected by the contractor, and the leak has been repaired, (2) the spill has been contained, and (3) NMFS and NOAA RC and/or the Corps are contacted and have evaluated the impacts of the spill. Absorbent and spill containment materials will otherwise be inspected regularly to ensure functionality.

- Effective erosion control measures shall be in place at all times during construction. Construction shall not start until all temporary control materials and devices (e.g., straw bales with sterile, weed-free straw, silt fences) are in place downslope or downstream of the work site within the riparian area. The materials shall be properly installed at all locations where the likelihood of sediment input exists. These materials shall be in place during and after construction activities for the purposes of minimizing fine sediment and sediment/water slurry input to flowing water and to detain sediment-laden water on site.

If continued erosion is likely to occur after construction is complete, then appropriate erosion prevention measures shall be implemented and maintained until erosion risk has subsided.

- Erosion control materials such as coir rolls or erosion control blankets will not contain plastic netting that could entrain reptiles (especially snakes) and amphibians.

- Sediment shall be removed from sediment control materials once it has reached one-third of the exposed height of the control, and placed in an upland location where it cannot be washed into federal or state jurisdictional waters.

- 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. If an erosion control measure fails and sediment is discharged, appropriate agencies should be notified within 48 hours of discovery.

- Temporary stockpiling of material onsite shall be minimized. Any excavated material shall be stockpiled in areas a sufficient distance from watercourses, where it cannot enter the stream channel. Prior to start of construction, the contractor shall determine if such sites are available at or near the project location. If onsite or nearby sites are unavailable, a location will be determined where material can be deposited. Spoils shall be contoured to disperse runoff and stabilized with mulch and (native) vegetation. Materials such as plastic sheeting held down with rocks or sandbags over stockpiles, silt fences, and berms of hay bales, shall be used to minimize movement of exposed or stockpiled soils from wind or precipitation.

- If feasible, topsoil shall be conserved for reuse at project location or use in other areas. Spoils shall be end-hauled away from watercourses as soon as possible to minimize potential sediment delivery.

- Immediately after project completion and before close of 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. All non-natural erosion control materials shall be removed after the project vicinity has fully stabilized. When seeding is used as an erosion control measure, only seeds from native plant species will be used. Sterile (without seeds), weed-free straw, free of exotic weeds, is required when hay or hay bales are used as erosion control measures.

- Precautions to minimize turbidity/siltation shall be taken into account during project planning and shall be implemented at the time of construction. This may require placing silt fencing, well-anchored sandbag or sheet pile cofferdams, temporary water bladder dams, coir logs, coir rolls, straw bale dikes, or other siltation barriers so that silt and/or other deleterious materials are not allowed to erode into downstream reaches. These barriers shall be placed at all locations where the likelihood of sediment input exists and shall be in place during construction activities, and afterward if necessary. If any sediment barrier fails to retain sediment, corrective measures shall be taken immediately.

General Measures to Limit the Effect of Instream Construction

- Where feasible, construction shall occur from the top of the stream bank, or on a temporary pad underlain with filter fabric.

- Use of heavy equipment shall be avoided, where possible, in a channel bottom with rocky or cobbled substrate. If access to the work site requires crossing a rocky or cobbled substrate, a rubber tire loader/backhoe shall be the preferred vehicle. Only after this option has been determined infeasible will the use of tracked vehicles be considered. The amount of time this equipment is stationed, working, or traveling within the creek bed shall be minimized. When heavy equipment is used, woody debris and vegetation on stream banks and in the channel shall not be disturbed if outside of the project's work area.

- When appropriate and with approval by NMFS, instream grade control structures may be utilized to control channel scour, sediment routing, and headwall cutting. Any such structures shall comply with NMFS fish passage guidelines.

- For relief culverts or structures, if a pipe or structure that empties flow from a non-fish bearing stream is installed, an energy dissipater shall be installed to reduce bed and bank scour. This does not apply to culverts or structures conveying flow that may be considered part of a fish-bearing stream. Any such structures shall comply with NMFS fish passage guidelines. The toe of rock slope protection used for streambank stabilization shall be placed sufficiently below the bed scour depth to ensure stability.

- When bioengineering bank stabilization options are not feasible due to site conditions, the amount of rock riprap and other structural materials used for stream bank protection shall be limited to the minimum needed for scour protection as determined by NOAA RC in coordination with NMFS. See Section 1.3.5 *Covered Project Types and Prohibited Activities* for more information on the bioengineering bank stabilization project type.

More detailed information on the timing of instream construction are listed above in "*In-water Work Windows*" of Section 1.3.4 *Programmatic Sideboards and Other Program Requirements*.

General Measures to Limit the Effect of Dewatering Activities and Fish Relocation

- 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 and both upstream and downstream fish passage during construction. The length of the dewatered stream channel and duration of dewatering, shall be minimized to the greatest extent practicable.

- As part of the initial submittal requirements, a dewatering and fish capture and relocation plan will be given to NMFS 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 (see "*Initial Project Screening*" Sub-Section in *Program Administration*).

- Fish shall be excluded from occupying the work area by blocking the stream channel above and below the work area with fine-meshed block nets or screens. Mesh will be no greater than 1/8-inch diameter. The bottom of a seine must be completely secured to the channel bed. Screens must be checked twice daily 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. Prior to dewatering a construction site, the qualified biologist shall capture and relocate fish and amphibians to avoid direct mortality and minimize adverse effects. This is especially important if listed species are present within the project site. Visqueen-type material shall be placed over sandbags used for construction of cofferdams to minimize water seepage into the work area. Visqueen material shall be firmly anchored to the streambed to minimize water seepage. 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. All work shall comply with NMFS' screening and passage guidelines (NMFS 1997, 2011c).

- Sediment-laden water shall be filtered or discharged from the construction area to an upland location or settling pond where it will not drain back into the stream channel. The settling pond may act as an infiltration basin so that water can be returned to the stream system while sediment is captured.

- 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 not be reduced at a rate greater than one inch per hour. This 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. 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 shall have a minimum of three years' field experience in the identification and capture of listed species, including adult and juvenile salmonids, considered in this opinion. The qualified biologist will adhere to the following requirements for capture and transport of listed fish species:

    - 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.

    - NMFS staff (identified as project contact) shall be notified one week prior to capture and relocation of listed fish to provide NMFS an opportunity to monitor the operation.

    - Initial fish relocation efforts will be conducted several days prior to the start of construction. This provides the biologist an opportunity to return to the work area and perform additional electrofishing passes immediately prior to construction. In many instances, additional fish will be captured that eluded the previous day's efforts.

    - 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).

- Water temperature, dissolved oxygen, and conductivity shall be recorded in an electrofishing log book, along with electrofishing settings.
- A minimum of one assistant shall aid the biologist by netting stunned fish and other aquatic vertebrates.
- 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; no more than 150 0+ fish (approximately six cubic inches per young-of-the-year (0+) individuals approximately) shall be allowed per five-gallon bucket, and fewer individuals per bucket shall be allowed for larger fish.
- Every effort shall be made not to mix (0+) salmonids with larger salmonids or other potential predators. At least two containers shall be used to 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, relocated 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. Adults will be placed upstream and juveniles downstream of the construction site. Captured fish shall be placed into a pool, preferably with a depth of greater than two feet with available instream cover. Owners of the land adjacent to the relocation site shall be contacted and briefed of the activities, if at all possible.
- All captured listed fish will be processed and released prior to conducting a subsequent electrofishing or seining pass.
- All native captured fish will be allowed to recover from electrofishing before being returned to the stream.

  - Handling of listed fish will be minimized to the greatest degree possible. When handling is necessary, hands or nets will always be wet prior to touching fish. Fish handlers will not wear DEET-based insect repellants.

  - 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. If water temperature reaches or exceeds 18°C, fish shall be released and rescue operations ceased.

  - In cases where aquatic vertebrates are especially abundant, periodically cease capture and release them at predetermined locations to ensure individuals are not contained for lengthy amounts of time.

  - Visually identify species and estimate year-classes of fishes at time of release. Record the number of fish captured. Avoid anesthetizing or measuring fish.

- If more than 3 percent of the steelhead or Chinook salmon or a single green sturgeon captured are killed or injured, the project lead shall contact the NMFS California Central Valley Office. The purpose of the contact is to allow the agencies to review the activities resulting in incidental take and to determine if additional protective measures are required. All steelhead and Chinook salmon mortalities must be retained, placed in an appropriately sized whirl-pak or zip-lock bag, labeled with the date and time of collection, fork length, location of capture, and frozen as soon as possible. Frozen samples must be retained until specific instructions are provided by NMFS.

General Measures to Limit the Effect of In-water Pile Driving

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. Measures will be implemented to minimize underwater sound pressure to levels below thresholds for peak pressure and accumulated sound exposure levels at a distance of ten meters. Threshold levels established by NMFS are:

peak pressure = 2	06 dB peak
accumulated sound exposure levels=	183 dB SEL

- 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 Section 1.3.3 *Program Administration* for further details on the project application process.

- If conditions allow, underwater sound monitoring shall be performed during pile-driving activities. Qualified personnel shall be present during such work to monitor construction activities and compliance with terms and conditions of permits or approvals.

- Pile driving shall occur during the established/approved in-water and general work windows.

- 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.

- Monitoring of fish shall occur during pile-driving activity to ensure no fish stranding or mortality occurs during the construction of the cofferdam (activities could include seining or snorkeling).

- Pile driving shall be conducted only during daylight hours and initially will be used at low energy levels and reduced impact frequency. Applied energy and frequency will be gradually increased until necessary full force and frequency are achieved.

- If it is determined that impact hammers are required and/or underwater sound monitoring demonstrates that thresholds are being exceeded, the contractor shall implement sound dampening or attenuation devices to reduce levels to the extent feasible; these may include the following:

    - A cushioning block shall be used between the hammer and pile.

    - A confined or unconfined air bubble curtain shall be used.

    - If feasible, pile driving could be done in the dry area (dewatered) behind the cofferdam.

General Measures to Limit the Effect of Vegetation/Habitat Disturbance

- Vegetation disturbance will be avoided and minimized to the extent practicable. Disturbed areas will be revegetated with native 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 preconstruction 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 80 percent survival of plantings or 80 percent ground cover for broadcast planting of seed, after a period of two years. 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. If at the end of 2 years, the vegetation has not successfully been re-established, the applicant will be responsible for replacement planting, additional watering, weeding, invasive exotic eradication, or any other practice, to achieve these requirements. If success is not achieved within the first two years, the project applicant will need to prepare a follow up report in an additional year's time.

- If erosion control fabrics are used in revegetated areas, they shall be slit in appropriate locations as necessary to allow for plant root growth. Only non-monofilament, wildlife-safe fabrics shall be used.

- To minimize ground and vegetation disturbance during project construction, prior to beginning project activities the applicant shall establish and clearly mark the project limits, including the boundaries of designated equipment staging areas; ingress and egress corridors; stockpile areas for spoils disposal, soil, and materials; and equipment exclusion zones.

- As many trees and brush shall be retained as practicable, emphasizing the retention of shade-producing and bank stabilizing trees and brush with greater than 3-inch diameter branches or trunks.

- 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.

- If riparian vegetation is to be removed with chainsaws, machines that operate with vegetable-based bar oil would be used, if possible.

- Any stream bank area left barren of vegetation as a result of the implementation or maintenance of the erosion control practices shall be restored to a natural state by seeding, planting, or other means with native trees, shrubs, or grasses prior to November

15 of the project year, or later depending on rainfall, with the approval of NMFS. Barren areas shall typically be planted with a combination of willow stakes, native shrubs and trees and/or erosion control grass mixes. Irrigation may also be required in order to ensure survival of containerized shrubs or trees.

- Native plant species shall be used for revegetation of disturbed and compacted areas. The species used shall be specific to the project vicinity or the region of the state where the project is located, and comprise a diverse community structure (plantings shall include both woody and herbaceous species).
- All plastic exclusion netting placed around plantings will be removed after 3 years.
- All invasive plant species (e.g., giant reed, tamarisk, *Arundo donax*, tree of heaven) shall, if feasible, be removed from the project site, destroyed using approved protocols, and disposed of at an appropriate upland disposal area.

For measures regarding chemical/herbicide application see the *"Invasive plant removal and revegetation"* Sub-Section, of Section 1.3.5 *Covered Project Types and Prohibited Activities.*

1.3.7 Monitoring and Reporting Requirements

The following monitoring and reporting requirements will be met by all Program applicants.

Pre-Project Monitoring Submittal Requirements

Individual project applicants will be required to submit a proposed monitoring plan for the project describing how they will ensure compliance with the applicable monitoring requirements described in this Program description (revegetation, etc.), including the source of funding for implementation of the monitoring plan. See Sub-Section "*Submittal Requirements"* of *Program Administration* (Section 1.3.3) for further information on pre-project submittal requirements.

Post-Construction Monitoring and Reporting Requirements

Applicants will also be required to fill out the Sacramento Office Programmatic Approach Post-Project Monitoring Form, which will be provided to applicants by the NOAA RC when their project is approved for the Program. In addition, see Sub-Section "*Submittal Requirements"* of *Program Administration* (Section 1.3.3) for further information on all application submittal requirements.

Implementation monitoring will be conducted for all projects implemented under the proposed Program. Following construction, individual applicants will submit a post-construction, implementation report to the NOAA RC. Submittal requirements will include project as-built plans describing post implementation conditions and photo documentation of project implementation taken before, during, and after construction utilizing CDFW photo monitoring protocols available on CDFW's website at https://www.wildlife.ca.gov/Conservation/Survey-Protocols. For fish relocation activities, the report will include all fisheries data collected by a qualified biologist including the number of listed salmonids killed or injured during the proposed action, the number and size (in millimeters) of listed salmonids captured and removed and any effects of the proposed action on listed salmonids and/or green sturgeon not previously considered. Applicant will work with the NOAA RC to update the NOAA database used for tracking salmonids killed or injured during a proposed action.

Monitoring Requirements for Off-channel/Side Channel Habitat Features

All off-channel/side channel habitat projects included in the Program will require additional physical and biological monitoring. In addition to the information collected during the pre-project monitoring and submittal requirements (above), the following information will also be collected by Program applicants and submitted to the NOAA RC:

- Pre- and post-project photo monitoring data (per CDFW's guidelines, and as described in Woodward and Hollar (2011));
- Project description, including
  - Project problem statement
  - Project goals and objectives, etc.
  - Watershed context
  - Description of the type of off-channel feature and restoration techniques utilized
  - Project dimensions
  - Description of outlet control feature (if present)
  - If dewatering of the work site will be necessary, description of temporary dewatering methods including qualified individual who will be onsite to transport protected salmonids
  - Construction start and end dates
  - Materials to be used
  - When vegetation is affected as a result of the project (including removal and replacement), a visual assessment of dominant native shrubs and trees, approximate species diversity, and approximate acreage
  - Description of existing site conditions and explanation of how proposed activities improve or maintain these conditions for Chinook salmon, steelhead, and/or green sturgeon move within the natural variability needed to support these species
  - Description of key habitat elements (i.e., temperature; habitat type: pool, riffle, flatwater; estimate of instream shelter and shelter components; water depth;

dominant substrate type, etc.) for Chinook salmon, steelhead, and/or green sturgeon in project vicinity

- Pre- and post-flow (after winter-flow event) information on the elevation of the inlet and outlet structure relative to the 2-year flood
- A description of if and when the off channel feature became disconnected from the main channel and at what flow level (cfs); this will require checking the project site daily when the off-channel feature is becoming disconnected from the main channel
- A description of any stranded fish observed; if salmonids or sturgeon are stranded, the applicant will contact NMFS immediately to determine if a fish rescue action is necessary.

Monitoring Schedule

Pre-project biological monitoring data should be collected at both the control and restoration sites in the year prior to project implementation in order to establish a project baseline. Fish and vegetation surveys and macroinvertebrate benthic and drift sample collection will occur multiple times during the spring and into the summer to capture full rearing and summer holding season. Snorkel surveys and sample benthic macroinvertebrates should be conducted at separate locations within a project footprint and at control locations.

Unless there is a very high flow event prior to restoration, pre-project physical habitat data (substrate and structural habitat mapping, bathymetry) may only need to be collected once, as these variables generally remain relatively stationary over a short time period, particularly if there are no high flow events.

Post-project monitoring following restoration ideally would be conducted for at least two years, and up to five years, subject to NOAA RC project review (depending on funding and/or project complexity), to increase the probability of capturing a range of environmental conditions. Longer-term monitoring of physical and biological habitat features over time and continued fish use of the restored habitat is recommended to determine the long-term sustainability of the site and whether additional actions are needed to maintain and improve off-channel habitat function. Less complex projects will be assessed for appropriate monitoring methods and timelines.

2. ENDANGERED SPECIES ACT: BIOLOGICAL OPINION AND INCIDENTAL TAKE STATEMENT

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

2.1 Analytical Approach

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

This opinion relies on the definition of "destruction or adverse modification," which "means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features" (81 FR 7214).

The designations of critical habitat for species uses the term primary constituent element (PCE) or essential features. The new critical habitat regulations (81 FR 7414) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a ''destruction or adverse modification'' analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

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

- Identify the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.

- Describe the environmental baseline in the action area.

- Analyze the effects of the proposed action on both species and their habitat using an "exposure-response-risk" approach.

- Describe any cumulative effects in the action area.

- Integrate and synthesize the above factors by: (1) reviewing the status of the species and critical habitat; and (2) adding the effects of the action, the environmental baseline, and cumulative effects to assess the risk that the proposed action poses to species and critical habitat.

- Reach a conclusion about whether species are jeopardized or critical habitat is adversely modified.

- If necessary, suggest a reasonable and prudent alternative (RPA) to the proposed action.

The purpose of the jeopardy analysis is to determine whether appreciable reductions of both the survival and recovery of the species in the wild are reasonably expected, but not to precisely quantify the amount of those reductions. For this analysis, NMFS equates a listed species' probability (or risk) of extinction with the likelihood of both the survival and recovery of the species in the wild. In the case of listed salmonids, NMFS uses the Viable Salmonid Population (VSP) framework (McElhany et al. 2000) as a bridge to the jeopardy standard. A designation of "a high risk of extinction" or "low likelihood of becoming viable" indicates that the species faces significant risks from internal and external processes that can drive it to extinction.

To apply this framework approach to the assessment of the Program, special consideration is given to Program administration (described in Section 1.3.3) to provide reasonable assurance that individual projects that do not conform to the Program criteria are not included in the Program. This consideration is also made to acknowledge the inherent limitation of analyzing the action when there is relative uncertainty regarding the place, timing, number, and type of projects will be implemented under the Program. As a result, this assessment often focuses on whether or not an appreciable reduction is expected; it does not focus on detailed analyses designed to quantify the absolute amount of reduction or the resulting population characteristics (absolute abundance, for example) that could occur as a result of Program implementation.

2.2 Rangewide Status of the Species and Critical Habitat

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

2.2.1 Sacramento River Winter-run Chinook Salmon

- First listed as threatened (54 FR 32085; August 4, 1989).

- Reclassified as endangered (59 FR 440; January 4, 1994); reaffirmed as endangered (70 FR 37160; June 28, 2005).

- Designated critical habitat (58 FR 33212; June 16, 1993).

The federally listed evolutionary significant unit (ESU) of Sacramento River winter-run Chinook salmon and designated critical habitat for this ESU occur in the action area and may be affected by the proposed action. Detailed information regarding ESU listing and critical habitat designation history, designated critical habitat, ESU life history, and viable salmonid population (VSP) parameters can be found in the 5-Year Status Review of Sacramento River Winter-Run Chinook Salmon ESU (NMFS 2016c).

Historically, Sacramento River winter-run Chinook salmon population estimates were as high as 120,000 fish in the 1960s, but declined to less than 200 fish by the 1990s (NMFS 2011b). In recent years, since carcass surveys began in 2001, the highest adult escapement occurred in 2005 and 2006 with 15,839 and 17,296, respectively (CDFW 2018). However, from 2007 to 2013, the population has shown a precipitous decline, averaging 2,486 during this period, with a low of 827 adults in 2011 (CDFW 2018). This recent declining trend is likely due to a combination of factors such as poor ocean productivity (Lindley et al. 2009), drought conditions from 2007 to 2009, and low in-river survival rates (NMFS 2011b). In 2014 and 2015, the population was approximately 3,000 adults, slightly above the 2007 to 2012 average, but below the high (17,296) for the last 10 years (CDFW 2018).

The year 2014 was the third year of a drought that increased water temperatures in the upper Sacramento River, and egg-to-fry survival to the Red Bluff Diversion Dam (RBDD) was approximately 5 percent (NMFS 2016c). Due to the anticipated lower than average survival in 2014, hatchery production from Livingston Stone National Fish Hatchery (LSNFH) was tripled (i.e., 612,056 released) to offset the impact of the drought (CVP and SWP Drought Contingency Plan 2014). In 2014, hatchery production represented 83 percent of the total in-river juvenile production. In 2015, egg-to-fry survival was the lowest on record (approximately 4 percent) due to the inability to release cold water from Shasta Dam in the fourth year of a drought. As expected, winter-run Chinook salmon returns were a low in 2016 with 1,546 adults returning (CDFW 2018) showing the drought impact on juveniles from brood year 2013 (NMFS 2016c). Although impacts from hatchery fish (i.e., reduced fitness, weaker genetics, smaller size, less ability to avoid predators) are often cited as having deleterious impacts on natural in-river populations (Matala et al. 2012), the winter-run Chinook salmon conservation program at LSNFH is strictly controlled by the USFWS to reduce such impacts. The average annual hatchery production at LSNFH is approximately 176,348 per year (2001 to 2010 average) compared to the estimated natural production that passes RBDD, which is 4.7 million per year based on the 2002 to 2010 average (Poytress and Carrillo 2011). Therefore, hatchery production typically represents approximately 3 to 4 percent of the total in-river juvenile winter-run production in any given year. However, the average over the last 12 years (about four generations) is 13 percent, with the most recent generation at 20 percent hatchery influence, making the population at a moderate risk of extinction.

The distribution of winter-run spawning and initial rearing historically was limited to the upper Sacramento River (upstream of Shasta Dam), McCloud River, Pitt River, and Battle Creek, where springs provided cold water throughout the summer, allowing for spawning, egg incubation, and rearing during the mid-summer period (Yoshiyama et al. 1998). The construction of Shasta Dam in 1943 blocked access to all of these waters except Battle Creek, which currently has its own impediments to upstream migration (i.e., a number of small hydroelectric dams situated upstream of the Coleman National Fish Hatchery (CNFH) weir). The Battle Creek Salmon and Steelhead Restoration Project (BCSSRP) is currently removing these impediments, restoring spawning and rearing habitat suitable for winter-run Chinook salmon in Battle Creek, which will be reintroduced to establish an additional population. Approximately 299 miles of former tributary spawning habitat above Shasta Dam are inaccessible to winter-run Chinook salmon. Yoshiyama et al. (2001) estimated that in 1938, the upper Sacramento River had a "potential spawning capacity" of approximately 14,000 redds equal to 28,000 spawners. Since 2001, the majority of winter-run chinook salmon redds have occurred in the first 10 miles downstream of Keswick Dam. Most components of the winter-run Chinook salmon life history (e.g., spawning, incubation, freshwater rearing) have been compromised by the construction of Shasta Dam.

The greatest risk factor for winter-run Chinook salmon lies within its spatial structure (NMFS 2011a). The winter-run Chinook salmon ESU is comprised of only one population that spawns below Keswick Dam. The remnant and remaining population cannot access 95 percent of their historical spawning habitat and must therefore be artificially maintained in the upper Sacramento River by spawning gravel augmentation, hatchery supplementation, and regulation of the finite cold water pool behind Shasta Dam to reduce water temperatures.

Winter-run Chinook salmon require cold water temperatures in the summer that simulate their upper basin habitat, and they are more likely to be exposed to the impacts of drought in a lower basin environment. Battle Creek is currently the most feasible opportunity for the ESU to expand its spatial structure with early implementation of reintroduction efforts occurring in 2018. The NMFS Central Valley Salmon and Steelhead Recovery Plan includes criteria for recovering the winter-run Chinook salmon ESU, including re-establishing a population into historical habitats in Battle Creek as well as upstream of Shasta Dam (NMFS 2014).

Winter-run Chinook salmon embryonic and larval life stages that are most vulnerable to warmer water temperatures occur during the summer, which makes the species particularly at risk from climate warming. The only remaining population of winter-run Chinook salmon relies on the cold water pool in Shasta Reservoir, which buffers the effects of warm temperatures in most years. The exception occurs during drought years, which are predicted to occur more often with climate change (Yates et al. 2008). The long-term projection of how the CVP and SWP will operate incorporates the effects of climate change in three possible forms: less total precipitation; a shift to more precipitation in the form of rain rather than snow; or, earlier spring snow melt (U.S. Bureau of Reclamation 2008). Additionally, air temperature appears to be increasing at a greater rate than what was previously analyzed (Lindley 2008; Beechie et al. 2012; Dimacali 2013). These factors will compromise the quantity and/or quality of winter-run Chinook salmon habitat available downstream of Keswick Dam. It is imperative for additional populations of winter-run Chinook salmon to be re-established into historical habitat in Battle Creek and above Shasta Dam for long-term viability of the ESU (NMFS 2014).

Summary of the Sacramento River Winter-run Chinook Salmon Evolutionarily Significant Unit Viability

There are several criteria that would qualify the winter-run Chinook salmon population at moderate risk of extinction (continued low abundance, a negative growth rate over two complete generations, significant rate of decline since 2006, increased hatchery influence on the population, and increased risk of catastrophe), and because there is still only one population that spawns below Keswick Dam, the Sacramento River winter-run Chinook salmon ESU is at a high risk of extinction in the long term. The extinction risk for the winter-run Chinook salmon ESU has increased from moderate risk to high risk of extinction since 2005, and several listing factors have contributed to the recent decline, including drought, poor ocean conditions, and hatchery influence (NMFS 2016c). Thus, large-scale fish passage and habitat restoration actions are necessary for improving the winter-run Chinook salmon ESU viability (NMFS 2016d).

Critical Habitat and Physical or Biological Features for Sacramento River Winter-run Chinook Salmon

The critical habitat designation for Sacramento River winter-run Chinook salmon lists the PBFs (58 FR 33212, 33216-33217; June 16, 1993), which are described in NMFS (2016a). This designation includes the following waterways, bottom and water of the waterways, and adjacent riparian zones: the Sacramento River from Keswick Dam (river mile (RM) 302) to Chipps Island (RM 0) at the westward margin of the Delta; all waters from Chipps Island westward to the Carquinez Bridge, including Honker Bay, Grizzly Bay, Suisun Bay, and the Carquinez Strait; all waters of San Pablo Bay westward of the Carquinez Bridge; and all waters of San Francisco Bay north of the San Francisco-Oakland Bay Bridge from San Pablo Bay to the Golden Gate Bridge (58 FR 33212; June 16, 1993). NMFS clarified that "adjacent riparian zones" are limited to only those areas above a stream bank that provide cover and shade to the nearshore aquatic areas (58 FR 33212, 33214; June 16, 1993). Although the bypasses (e.g., Yolo, Sutter, and Colusa) are not currently designated critical habitat for winter-run Chinook salmon, NMFS recognizes that they may be utilized when inundated with Sacramento River flood flows and are important rearing habitats for juvenile winter-run. Also, juvenile winter-run Chinook salmon may use tributaries of the Sacramento River for non-natal rearing (Maslin et al. 1997, PFMC and NMFS 2014).

Summary of Sacramento River Winter-run Chinook Salmon Critical Habitat

Currently, many of the PBFs of winter-run Chinook salmon critical habitat are degraded and provide limited high quality habitat. Factors that lessen the quality of migratory corridors for juveniles include unscreened diversions, altered flows in the Delta, and the lack of floodplain habitat. In addition, water operations that limit the extent of cold water below Shasta Dam have reduced the available spawning habitat (based on water temperature). Although the current conditions of winter-run Chinook salmon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species.

2.2.2 Central Valley Spring-run Chinook Salmon

- Listed as threatened (64 FR 50394; September 16, 1999); reaffirmed (70 FR 37160; June 28, 2005).
- Designated critical habitat (70 FR 52488; September 2, 2005).

The federally listed ESU of CV spring-run Chinook salmon and designated critical habitat for this ESU occur in the action area and may be affected by the Program. Detailed information regarding ESU listing and critical habitat designation history, designated critical habitat, ESU life history, and VSP parameters can be found in the 5-Year Status Review of Central Valley Spring-run Chinook Salmon ESU (NMFS 2016b). Historically, CV spring-run Chinook salmon were the second most abundant salmon run in the Central Valley and one of the largest on the west coast (CDFG 1990). These fish occupied the upper and middle elevation reaches (1,000 to 6,000 feet) of the San Joaquin, American, Yuba, Feather, Sacramento, McCloud and Pit rivers, with smaller populations in most tributaries with sufficient habitat for over-summering adults (Stone 1872, Rutter 1904, Clark 1929). The Central Valley drainage as a whole is estimated to have supported CV spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (CDFG 1998). The San Joaquin River historically supported a large run of CV spring-run Chinook salmon, suggested to be one of the largest runs of any Chinook salmon on the West Coast, with estimates averaging 200,000 to 500,000 adults returning annually (CDFG 1990).

Monitoring of the Sacramento River mainstem during CV spring-run Chinook salmon spawning timing indicates some spawning occurs in the river (CDFW 2015). Genetic introgression has likely occurred here due to lack of physical separation between spring-run and fall-run Chinook salmon populations (CDFG 1998). Battle Creek and the upper Sacramento River represent persisting populations of CV spring-run Chinook salmon in the basalt and porous lava diversity group, though numbers remain low. Other Sacramento River tributary populations in Mill, Deer, and Butte creeks are likely the best trend indicators for the CV spring-run Chinook salmon ESU. Generally, these streams showed a positive escapement trend between 1991 and 2006, displaying broad fluctuations in adult abundance (NMFS 2016b). The Feather River Fish Hatchery (FRFH) CV spring-run Chinook salmon population represents an evolutionary legacy of populations that once spawned above Oroville Dam. The FRFH population is included in the ESU based on its genetic linkage to the natural spawning population and the potential for development of a conservation strategy (70 FR 37160; June 28, 2005).

The Central Valley Technical Review Team (TRT) estimated that historically there were 18 or 19 independent populations of CV spring-run Chinook salmon, along with a number of dependent populations, all within four distinct geographic regions (i.e., diversity groups) (Lindley et al. 2004). Of these populations, only three independent populations currently exist (Mill, Deer, and Butte creeks tributary to the upper Sacramento River), and they represent only the northern Sierra Nevada diversity group. Additionally, smaller populations are currently persisting in Antelope and Big Chico creeks and the Feather and Yuba Rivers in the northern Sierra Nevada diversity group (CDFG 1998). The northwestern California diversity group has two low-abundance persisting populations of spring-run Chinook salmon in Clear and Beegum creeks. In the San Joaquin River basin, the southern Sierra Nevada diversity group, observations in the last decade suggest that spring-running populations may currently occur in the Stanislaus and Tuolumne rivers (Franks 2014).

The CV spring-run Chinook salmon ESU is comprised of two known genetic complexes. Analysis of natural and hatchery spring-run Chinook salmon stocks in the Central Valley indicates that the northern Sierra Nevada diversity group spring-run Chinook salmon populations in Mill, Deer, and Butte creeks retain genetic integrity as opposed to the genetic integrity of the Feather River population, which has been somewhat compromised by introgression with the fall-run ESU (Good et al. 2005; Garza et al. 2008; Cavallo et al. 2011).

Because the populations in Butte, Deer, and Mill creeks are the best trend indicators for ESU viability, NMFS can evaluate risk of extinction based on VSP in these watersheds. Over the long term, these three remaining populations are considered to be vulnerable to anthropomorphic and naturally occurring catastrophic events. The viability assessment of CV spring-run Chinook salmon, conducted during NMFS' 2010 status review (NMFS 2011a), found that the biological status of the ESU had worsened since the last status review (2005), and the status review recommends that the species status be reassessed in 2 to 3 years as opposed to waiting another 5 years if the decreasing trend continued. In 2012 and 2013, most tributary populations increased in returning adults, averaging more than 13,000. However, 2014 returns were lower again—approximately 5,000 fish—indicating the ESU remains highly fluctuating. The most recent status review was conducted in 2015 (NMFS 2016b), and it looked at promising increasing populations in 2012 to 2014; however, the 2015 returning fish were extremely low (1,488), with additional pre-spawn mortality reaching record lows. Since the effects of the 2012 to 2015 drought have not been fully realized, NMFS anticipates at least several more years of very low returns, which may result in severe rates of decline (NMFS 2016b).

Spring-run Chinook salmon adults are vulnerable to climate change because they over-summer in freshwater streams before spawning in autumn (Thompson et al. 2011). CV spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and those tributaries without cold water refugia (usually input from springs) will be more susceptible to impacts of climate change. Even in tributaries with cool water springs, in years of extended drought and warming water temperatures, unsuitable conditions may occur. Additionally, juveniles often rear in the natal stream for one to two summers prior to emigrating, and they would be susceptible to warming water temperatures. In Butte Creek, fish are limited to low elevation habitat that is currently thermally marginal, as demonstrated by high summer mortality of adults in 2002, 2003, and 2015, and will become intolerable within decades if the climate warms as expected. Ceasing water diversion for power production from the summer holding reach in Butte Creek resulted in cooler water temperatures, more adults surviving to spawn, and extended population survival time (Mosser et al. 2013).

Summary of the Central Valley Spring-run Chinook Salmon Evolutionarily Significant Unit Viability

In summary, the extinction risk for the CV spring-run Chinook salmon ESU was evaluated for years 2012 – 2014, and the risk of extinction remained moderate (Williams et al. 2016). However, based on the severity of the drought and the low escapements, as well as increased prespawn mortality in Butte, Mill, and Deer creeks in 2015, there is concern that these CV spring-run Chinook salmon strongholds will deteriorate into high extinction risk in the coming years based on the population size or rate of decline criteria (NMFS 2016b).

Critical Habitat and Physical or Biological Features for Central Valley Spring-run Chinook Salmon

The critical habitat designation for CV spring-run Chinook salmon lists the PBFs (70 FR 52488; September 2, 2005), which are described in NMFS 2016b. In summary, the PBFs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine habitat. The geographic range of designated critical habitat includes stream reaches of the Sacramento, Feather, Yuba, and American rivers; Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks; and the Sacramento River as well as portions of the northern Delta (70 FR52488; September 2, 2005).

Summary of Central Valley Spring-run Chinook Salmon Critical Habitat

Currently, many of the PBFs of CV spring-run Chinook salmon critical habitat are degraded and provide limited high quality habitat. Factors that lessen the quality of migratory corridors for juveniles include unscreened or inadequately screened diversions, altered flows in the Delta, scarcity of complex in-river cover, and the lack of floodplain habitat. Although the current conditions of CV spring-run Chinook salmon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain are considered to have high intrinsic value for the conservation of the species.

2.2.3 California Central Valley Steelhead

- Originally listed as threatened (63 FR 13347; March 19, 1998); reaffirmed (71 FR 834; January 5, 2006).
- Designated critical habitat (70 FR 52488; September 2, 2005).

The federally listed DPS of California Central Valley (CCV) steelhead and designated critical habitat for this DPS occur in the action area and may be affected by the Program. Detailed information regarding DPS listing and critical habitat designation history, designated critical habitat, DPS life history, and VSP parameters can be found in the 5-Year Status Review of California Central Valley Steelhead Distinct Population Segment (NMFS 2016a).

Historic CCV steelhead run sizes are difficult to estimate given the paucity of data, but may have approached one to two million adults annually (McEwan 2001). By the early 1960s, the CCV steelhead run size had declined to about 40,000 adults (McEwan 2001). Current abundance data for CCV steelhead are limited to returns to hatcheries and redd surveys conducted on a few rivers. The hatchery data are the most reliable because redd surveys for steelhead are often made difficult by high flows and turbid water usually present during the winter-spring spawning period.

CCV steelhead returns to CNFH increased from 2011 to 2014 (see NMFS 2016a for further information). After hitting a low of only 790 fish in 2010, 2013 and 2014 have averaged 2,895 fish. Wild adults counted at the hatchery each year represent a small fraction of overall returns, but their numbers have remained relatively steady, typically 200 to 300 fish each year. Numbers of wild adults returning each year ranged from 252 to 610 from 2010 to 2014, respectively.

Redd counts are conducted in the American River and in Clear Creek (Shasta County). An average of 143 redds have been counted on the American River from 2002 to 2015 (data from Hannon et al. 2003; Hannon and Deason 2008; Chase 2010). An average of 178 redds have been counted in Clear Creek from 2001 to 2015 following the removal of Saeltzer Dam, which allowed steelhead access to additional spawning habitat. The Clear Creek redd count data ranges from 100 to 1,023 and indicates an upward trend in abundance since 2006 (USFWS 2015a). The returns of CCV steelhead to the FRFH experienced a sharp decrease from 2003 to 2010, with only 679, 312, and 86 fish returning in 2008, 2009 and 2010, respectively. In recent years, however, returns have experienced an increase, with 830, 1,797, and 1,505 fish returning in 2012, 2013, and 2014, respectively. Overall, steelhead returns to hatcheries have fluctuated so much from 2001 to 2015 that no clear trend is present.

An estimated 100,000 to 300,000 naturally produced juvenile steelhead are estimated to leave the Central Valley annually, based on rough calculations from sporadic catches in trawl gear (Good et al. 2005). Nobriga and Cadrett (2001) used the ratio of adipose fin-clipped (hatchery) to unclipped (wild) steelhead smolt catch ratios in the USFWS Chipps Island trawl from 1998 through 2000 to estimate that about 400,000 to 700,000 steelhead smolts are produced naturally each year in the Central Valley. Trawl data indicate that the level of natural production of steelhead has remained very low since the 2011 status review, suggesting a decline in natural production based on consistent hatchery releases. Catches of steelhead at the fish collection facilities in the southern Delta are another source of information on the production of wild steelhead relative to hatchery steelhead (CDFW). The overall catch of steelhead has declined dramatically since the early 2000s, with an overall average of 2,705 in the last 10 years. The percentage of wild (unclipped) fish in salvage has fluctuated, but has leveled off to an average of 36 percent since a high of 93 percent in 1999.

About 80 percent of the historical spawning and rearing habitat once used by CCV steelhead in the Central Valley is now upstream of impassible dams (Lindley et al. 2006). Many historical populations of CCV steelhead are entirely above impassable barriers and may persist as resident or adfluvial rainbow trout, although they are presently not considered part of the DPS. Steelhead are well-distributed throughout the Central Valley below the major rim dams (Good et al. 2005, NMFS 2016a). Most of the steelhead populations in the Central Valley have a high hatchery component, including Battle Creek (adults intercepted at the CNFH weir), the American River, Feather River, and Mokelumne River.

The CCV steelhead abundance and growth rates continue to decline, largely the result of a significant reduction in the amount and diversity of habitats available to these populations (Lindley et al. 2006). Recent reductions in population size are supported by genetic analysis (Nielsen et al. 2003). Garza and Pearse (2008) analyzed the genetic relationships among CCV steelhead populations and found that unlike the situation in coastal California watersheds, fish below barriers in the Central Valley were often more closely related to below barrier fish from other watersheds than to *O. mykiss* above barriers in the same watershed. This pattern suggests the ancestral genetic structure is still relatively intact above barriers, but may have been altered below barriers by stock transfers. The genetic diversity of CCV steelhead is also compromised by hatchery origin fish, placing the natural population at a high risk of extinction (Lindley et al. 2007). Steelhead in the Central Valley historically consisted of both summer-run and winter-run Chinook salmon migratory forms. Only winter-run (ocean maturing) steelhead currently are found in California Central Valley rivers and streams as summer-run have been extirpated (McEwan and Jackson 1996; Moyle 2002).

Although CCV steelhead will experience similar effects of climate change to Chinook salmon in the Central Valley, as they are also blocked from the vast majority of their historic spawning and rearing habitat, the effects may be even greater in some cases, as juvenile steelhead need to rear in the stream for one to two summers prior to emigrating as smolts. In the Central Valley, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 57 degrees Fahrenheit (°F) to 66°F (14 degrees Celsius (°C) to 19°C). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than salmon (McCullough et al. 2001). In fact, McCullough et al. (2001) recommended an optimal incubation temperature at or below 52°F to 55°F (11°C to 13°C). Successful smoltification in steelhead may be impaired by temperatures above 54°F (12°C), as reported in Richter and Kolmes (2005). As stream temperatures warm due to climate change, the growth rates of juvenile steelhead could increase in some systems that are currently relatively cold, but potentially at the expense of decreased survival due to higher metabolic demands and greater presence and activity of predators. Stream temperatures that are currently marginal for spawning and rearing may become too warm to support wild steelhead populations.

Summary of California Central Valley Steelhead Distinct Population Segment Viability

All indications are that natural CCV steelhead have continued to decrease in abundance and in the proportion of natural fish over the past 25 years (Good et al. 2005; NMFS 2016a); the long-term trend remains negative. Hatchery production and returns are dominant. Most wild CCV populations are very small and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to wild fish.

In summary, the status of the CCV steelhead DPS appears to have remained unchanged since the 2011 status review, and the DPS is likely to become endangered within the near future throughout all or a significant portion of its range (NMFS 2016a).

Critical Habitat and Physical or Biological Features for California Central Valley Steelhead

The critical habitat designation for CCV steelhead lists the PBFs (70 FR 52488; September 2, 2005), which are described in NMFS (2016a). In summary, the PBFs include freshwater spawning sites; freshwater rearing sites; freshwater migration corridors; and estuarine areas. The geographic extent of designated critical habitat includes the following: The Sacramento, Feather, and Yuba rivers and the Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries but excluding the mainstem San Joaquin River above the Merced River confluence; and the waterways of the Delta.

Summary of California Central Valley Steelhead Critical Habitat

Many of the PBFs of CCV steelhead critical habitat are degraded and provide limited high quality habitat. Passage to historical spawning and juvenile rearing habitat has been largely reduced due to construction of dams throughout the Central Valley. Levee construction has also degraded the freshwater rearing and migration habitat and estuarine areas as riparian vegetation has been removed, reducing habitat complexity and food resources and resulting in many other ecological effects. Contaminant loading and poor water quality in central California waterways pose threats to lotic fish, their habitat, and food resources. Additionally, due to reduced access to historical habitats, genetic introgression is occurring because naturally produced fish are interacting with hatchery-produced fish, which has the potential to reduce the long-term fitness and survival of this species.

Although the current conditions of CCV steelhead critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in the Sacramento-San Joaquin River watersheds and the Delta are considered to have high intrinsic value for the conservation of the species as they are critical to ongoing recovery efforts.

2.2.4 Southern Distinct Population Segment of North American Green Sturgeon

- Listed as threatened (71 FR 17757; April 7, 2006).
- Designated critical habitat (74 FR 52300; October 9, 2009).

The federally listed sDPS of North American green sturgeon and designated critical habitat for this DPS occur in the action area and may be affected by the Program. Detailed information regarding DPS listing and critical habitat designation history, designated critical habitat, DPS life history, and VSP parameters can be found in the 5-year Status Review of the Southern Distinct Population Segment of the North American Green Sturgeon (NMFS 2015a).

Green sturgeon are known to range from Baja California to the Bering Sea along the North American continental shelf. During late summer and early fall, subadults and non-spawning adult green sturgeon can frequently be found aggregating in estuaries along the Pacific coast (Emmett et al. 1991; Moser and Lindley 2006). Using polyploid microsatellite data, Israel et al. (2009b) found that green sturgeon within the Central Valley of California belong to the sDPS. Additionally, acoustic tagging studies have found that green sturgeon found spawning within the Sacramento River are exclusively sDPS green sturgeon (Lindley et al. 2011). In waters inland from the Golden Gate Bridge in California, sDPS green sturgeon are known to range through the estuary and the Delta and up the Sacramento, Feather, and Yuba rivers (Israel et al. 2009a, Seesholtz et al. 2015). It is unlikely that green sturgeon utilize areas of the San Joaquin River upriver of the Delta with regularity, and spawning events are thought to be limited to the upper Sacramento River and its tributaries. There is no known modern usage of the upper San Joaquin River by green sturgeon, and adult spawning has not been documented there (Jackson and Van Eenennaam 2012).

Recent research indicates that the sDPS is composed of a single, independent population, which principally spawns in the mainstem Sacramento River and also breeds opportunistically in the

Feather River and possibly the Yuba River (Seesholtz et al. 2014). Concentration of adults into a very few select spawning locations makes the species highly vulnerable to poaching and catastrophic events. The apparent, but unconfirmed, extirpation of spawning populations from the San Joaquin River narrows the available habitat within their range, offering fewer habitat alternatives. Whether sDPS green sturgeon display diverse phenotypic traits, such as ocean behavior, age at maturity, and fecundity, or if there is sufficient diversity to buffer against long-term extinction risk is not well understood. It is likely that the diversity of sDPS green sturgeon is low, given recent abundance estimates (NMFS 2015b).

Trends in abundance of sDPS green sturgeon have been estimated from two long-term data sources: (1) salvage numbers at the state and Federal pumping facilities (CDFW), and (2) by incidental catch of green sturgeon by the CDFW's white sturgeon sampling/tagging program (Dubois et al. 2011). Historical estimates from these sources are likely unreliable because the sDPS was likely not taken into account in incidental catch data, and salvage does not capture rangewide abundance in all water year types. A decrease in sDPS green sturgeon abundance has been inferred from the amount of take observed at the south Delta pumping facilities, the Skinner Delta Fish Protection Facility (SDFPF), and the Tracy Fish Collection Facility (TFCF). This data should be interpreted with some caution. Operations and practices at the facilities have changed over the project lifetime, which may affect salvage data. These data likely indicate a high production year versus a low production year qualitatively, but cannot be used to rigorously quantify abundance.

Since 2010, more robust estimates of sDPS green sturgeon have been generated. Researchers at the University of California, Davis used acoustic telemetry to locate green sturgeon in the Sacramento River and to derive an adult spawner abundance estimate (Mora et al. 2015). Preliminary results of these surveys estimate an average annual spawning run of 223 (using dual-frequency identification sonar (DIDSON)) and 236 (using telemetry) fish. This estimate does not include the number of spawning adults in the lower Feather or Yuba rivers, where green sturgeon spawning was recently confirmed (Seesholtz et al. 2015).

The parameters of green sturgeon population growth rate and carrying capacity in the Sacramento Basin are poorly understood. Larval count data shows enormous variance among sampling years. In general, sDPS green sturgeon year class strength appears to be highly variable with overall abundance dependent upon a few successful spawning events (NMFS 2010a). Other indicators of productivity such as data for cohort replacement ratios and spawner abundance trends are not currently available for sDPS green sturgeon.

The sDPS green sturgeon spawn primarily in the Sacramento River in the spring and summer. The Anderson-Cottonwood Irrigation District Diversion Dam (ACID) is considered the upriver extent of green sturgeon passage in the Sacramento River (71 FR 17757; April 7, 2006). The upriver extent of green sturgeon spawning, however, is approximately 30 kilometers downriver of ACID where water temperature is higher than ACID during late spring and summer (NMFS 2018). Thus, if water temperatures increase with climate change, temperatures adjacent to ACID may remain within tolerable levels for the embryonic and larval life stages of green sturgeon, but temperatures at spawning locations lower in the river may be more affected. It is uncertain, however, if green sturgeon spawning habitat exists closer to ACID, which could allow spawning to shift upstream in response to climate change effects. Successful spawning of green sturgeon in other accessible habitats in the Central Valley (i.e., the Feather River) is limited, in part, by late spring and summer water temperatures (NMFS 2015a). Similar to salmonids in the Central Valley, green sturgeon spawning in tributaries to the Sacramento River is likely to be further limited if water temperatures increase and higher elevation habitats remain inaccessible.

Summary of Green Sturgeon Southern Distinct Population Segment Viability

The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. The risk of extinction is believed to be moderate (NMFS 2010a). Although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the viability of population abundance indices (NMFS 2010b). Lindley et al. (2008), in discussing winter-run Chinook salmon, states that an ESU (or DPS) represented by a single population at moderate risk of extinction is at high risk of extinction over a large timescale; this would apply to the sDPS for green sturgeon. The most recent 5-year status review for sDPS green sturgeon found that some threats to the species have recently been eliminated, such as take from commercial fisheries and removal of some passage barriers (NMFS 2015a). However, since many of the threats cited in the original listing still exist, the threatened status of the DPS is still applicable (NMFS 2015a).

Critical Habitat and Physical or Biological Features for Southern Distinct Population Segment Green Sturgeon

The critical habitat designation for sDPS green sturgeon lists the PBFs (74 FR 52300; October 9, 2009), which are described in NMFS 2015b. In summary, the PBFs include the following for both freshwater riverine systems and estuarine habitats: food resources, water flow, water quality, migratory corridor, depth, and sediment quality. Additionally, substrate type or size is also a PBF for freshwater riverine systems. In addition, the PBFs include migratory corridor, water quality, and food resources in nearshore coastal marine areas. The geographic range of designated critical habitat includes the following:

- In freshwater, the geographic range includes:

    - The Sacramento River from the Sacramento I Street bridge to Keswick Dam, including the Sutter and Yolo bypasses and the lower American River from the confluence with the mainstem Sacramento River upstream to the highway 160 bridge. - The Feather River from its confluence with the Sacramento River upstream to Fish Barrier Dam.

    - The Yuba River from its confluence with the Feather River upstream to Daguerre Point Dam.

    - The Delta (as defined by California Water Code Section 12220, except for listed excluded areas).

- In coastal bays and estuaries, the geographic range includes:

- San Francisco, San Pablo, Suisun, and Humboldt bays in California.
- Coos, Winchester, Yaquina, and Nehalem bays in Oregon.
- Willapa Bay and Grays Harbor in Washington.
- the lower Columbia River estuary from the mouth to river kilometer (RK) 74.

In coastal marine waters, the geographic range includes all United States coastal marine waters out to the 60-fathom-depth bathymetry line from Monterey Bay north and east to include waters in the Strait of Juan de Fuca, Washington.

Summary of Southern Distinct Population Segment Green Sturgeon Critical Habitat

Currently, many of the PBFs of sDPS green sturgeon are degraded and provide limited high-quality habitat. Factors that lessen the quality of migratory corridors for juveniles include unscreened or inadequately screened diversions, altered flows in the Delta, and presence of contaminants in sediment. Although the current conditions of green sturgeon critical habitat are significantly degraded, the spawning habitat, migratory corridors, and rearing habitat that remain in both the Sacramento-San Joaquin River watersheds, the Delta, and nearshore coastal areas are considered to have high intrinsic value for the conservation of the species.

2.3 Action Area

"Action area" means all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). Not knowing the location, timing and size of projects covered by the Program, it is difficult to determine the extent of all areas affected directly or indirectly. Instead the action area is determined by the Program and it includes all stream channels, riparian areas, and hydrologically linked upslope areas that will be affected by the implementation of restoration projects included in the Program.

Restoration projects, that otherwise qualify and that occur within the area of NMFS CCVO jurisdiction could potentially occur within any stream occupied by the ESUs and DPSs located in the California Central Valley (Figure 1). The action area includes, either in whole or in part, the following hydrologic unit code (HUC) 8 sub-basins, as defined by United States Geological Survey (USGS): Cottonwood Headwaters, Honcut Headwaters, Lower American, Lower Bear, Lower Butte, Lower Calaveras – Mormon Slough, Lower Cosumnes – Lower Mokelumne, Lower Cottonwood, Lower Feather, Lower Sacramento, Lower Yuba, Middle San Joaquin – Lower Chowchilla, Middle San Joaquin – Lower Merced – Lower Stanislaus, Mill – Big Chico, North Fork Feather, Panoche – San Luis Reservoir, Sacramento – Lower Cow – Lower Clear, Sacramento – Lower Thomes, Sacramento – Stone Corral, Sacramento – Upper Clear, San Joaquin Delta, Upper Bear, Upper Butte, Upper Calaveras, Upper Chowchilla – Upper Fresno, Upper Coon – Upper Auburn, Upper Cosumnes, Upper Cow-Battle, Upper Elder – Upper Thomes, Upper Merced, Upper Mokelumne, Upper San Joaquin, Upper Stanislaus, and Upper Tuolumne.

2.4 Environmental Baseline

The "environmental baseline" includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02).

The proposed action area encompasses the entire freshwater range of the listed fish species and their proposed or designated critical habitat in this consultation. Section 2.2, *Rangewide Status of the Species and Critical Habitat* provides general information on the fish species' biology, status, and factors affecting abundance at the species scale. General discussion of the environmental baseline for fish species follows in this section.

Because this programmatic consultation covers specific projects, which are yet to be determined, the current condition of fish or critical habitats at potential project sites and the conservation role those specific areas may play cannot be defined at this time. Therefore, to complete the effects analyses, jeopardy analyses and destruction or adverse modification of critical habitat analyses in this consultation, we made the following assumptions regarding the environmental baseline in each area that will eventually be identified to support an action: (1) The purpose of the proposed action is to facilitate restoration projects for the benefit of listed aquatic species; (2) each individual project's action area will be occupied by or be critical habitat for one or more listed species; (3) the biological requirements of individual fish in those areas are not currently being fully met because aquatic habitat functions, including functions related to habitat factors limiting the recovery of the species in each area, are impaired; and (4) active restoration at each site is likely to improve the factors limiting recovery of federally listed fish in that area.

2.4.1 Status of the Species in the Action Area

This section is organized by species and cross referenced with the four management units described in Section 1.3.4 *Programmatic Sideboards and Other Program Requirements*.

Sacramento River Winter-run Chinook Salmon

Status of Sacramento River Winter-run Chinook in the Action Area

The action area encompasses the entire critical habitat designation for winter-run Chinook salmon and includes almost all habitats used throughout the life cycle of this species. Assessing the temporal occurrence of each life stage of winter-run Chinook in the action area is done through monitoring data in the Sacramento River and Delta as well as salvage data from the Tracy and Skinner fish collection facilities in the south Delta (CVP and SWP) (Table 2-1).

Table 2-1. The Temporal Occurrence of Adult (a) and Juvenile (b) Winter-run Chinook Salmon in the Sacramento River.

Relative Abundance					Medium					Low		
a) Adults freshwater												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento River basin[a,b]												
Upper Sacramento River spawning[c]												
Delta												
b) Juvenile emigration												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sacramento River at Red Bluff[d]												
Sacramento River at Knights Landing[e]												
Sacramento trawl at Sherwood Harbor[f]												
Midwater trawl at Chipps Island[g]												

Sources: a: Yoshiyama et al. (1998); Moyle (2002); b: Myers et al. (1998); c: Williams (2006); d: Martin et al. (2001); e: Knights Landing Rotary Screw Trap Data, CDFW (1999-2011); f,g: Delta Juvenile Fish Monitoring Program, USFWS (1995-2012)

Adult winter-run Chinook salmon begin their upstream migration through the Sacramento/San Joaquin Delta (MU3) in December and continue through July with a peak occurring between the months of December and April (NMFS 2014). Adult winter-run Chinook salmon return from the ocean prior to reaching full sexual maturity and hold in the Sacramento River for several months before spawning while they mature. Currently, the spawning range of winter-run Chinook salmon is confined to the Sacramento River between Red Bluff Diversion Dam (RBDD) (RM 243) and Keswick Dam (RM 302) (Vogel and Marine 1991; NMFS 2014). Historically, spawning likely occurred upstream of Shasta Dam in spawning reaches which are no longer accessible to anadromous fish (Yoshiyama et al. 1998), as well as in an upper tributary to the Sacramento River, Battle Creek (Lindley et al. 2004).

The upper Sacramento River below Keswick Dam portion of the action area, described by MU1, is critically important for the survival and recovery of this species as it contains the only known remaining spawning grounds. As winter-run spawning occurs in the summer months, naturally-occurring summer flows in river reaches below Keswick Dam, where this species currently spawns, would have precluded spawning historically. This suggests that the area below Shasta and Keswick dams was likely utilized for winter-run juvenile rearing and migration only. Currently, flows in the Sacramento River are artificially managed at both Keswick and Shasta dams in order to provide appropriate spawning and egg incubation temperatures and flows through winter-run Chinook salmon spawning grounds (Boles 1988, Yates et al. 2008, NMFS 2014). There is an ongoing effort to restore 42 miles of salmon habitat on Battle Creek in MU4 as part of the Battle Creek Salmon and Steelhead Restoration Project (Bottom et al. 2005), leading to Pacific Gas and Electric's application to the Federal Energy Regulatory Commission to modify operations of hydropower projects on North Fork and South Fork Battle Creek (NMFS 2009b). These improved flows and re-opening of spawning and rearing habitat is expected to benefit winter-run Chinook salmon when reintroduced to the stream, and to aid in the recovery of this species.

There are uncertainties about Reclamation's ability to maintain an adequate cold water pool in Shasta Reservoir in order to maintain suitable temperatures for winter-run Chinook salmon egg incubation, fry emergence, and juvenile rearing in the Sacramento River in critically dry years and extended drought periods. Through NMFS' 2009 biological opinion on the long-term water operations of the CVP/SWP (NMFS 2009a), Reclamation has created and implemented Shasta Reservoir storage plans and year-round Keswick Dam release schedules and procedures with the goal of providing cold water for spawning and rearing (NMFS 2016c).

However, warm-water releases from Shasta Dam have been a significant stressor to winter-run Chinook salmon, especially given the recent extended drought in California from 2012 through 2015 (NMFS 2016c). Warm water releases from Shasta Reservoir in 2014 and 2015 contributed to 5.9 percent and 4.2 percent egg-to-fry survival rates respectively, to RBDD. Under varying hydrologic conditions from 2002 to 2013, winter-run Chinook salmon egg-to-fry survival ranged from three to nearly 10 times higher than in 2014 and 2015. Measures taken as part of a coordinated drought response (Swart 2016) to reduce this threat and improve Shasta Reservoir cold water pool management have been to: (1) relax Wilkins Slough navigational flow requirements; (2) relax D-1641 Delta water quality requirements; (3) delay Sacramento River Settlement Contractor depletions, and transfer a volume of their water in the fall rather than increase depletions throughout the summer; (4) target slightly warmer temperatures during the winter-run Chinook salmon holding period (before spawning occurs); (5) replace the Spring Creek and Oak Bottom temperature control curtains in Whiskeytown Reservoir; and (6) install the Shasta Dam temperature control device curtain in 2015 (NMFS 2016c). Other efforts to reduce the likelihood of warm water releases from Shasta Dam include improving reservoir, meteorologic, and hydrologic modeling and monitoring in order to most efficiently and effectively manage the reservoir's limited amount of cold water, installation of additional temperature monitoring stations in the upper Sacramento River to better monitor real-time water temperatures, and enhanced redd, egg, and juvenile winter-run Chinook salmon monitoring (NMFS 2016c).

The Livingston Stone National Fish Hatchery began operation in 1997 and functions to supplement the naturally occurring population of Sacramento River winter-run Chinook salmon in order to aid in its survival and recovery (California Hatchery Scientific Review Group (California HSRG) 2012). The facility is intended to be a temporary conservation measure and will cease operations once the population of winter-run Chinook salmon is considered to be viable and fully recovered. Winter-run that are produced at LSNFH are intended to return to the upper Sacramento River as adults and become reproductively and genetically assimilated into the natural population (California HSRG 2012). In order to improve hatchery management, the USFWS has developed and implemented a secondary fish trapping location for the LSNFH winter-run Chinook salmon supplementation program at the Anderson-Colusa Irrigation District dam to provide increased opportunity to capture a spatially representative sample and target numbers of broodstock (USFWS 2015b). This hatchery program is expected to play a continuing role as a conservation hatchery to help recover winter-run Chinook salmon. The LSNFH captive broodstock and supplementation Hatchery and Genetic Management Plans are complete and currently undergoing section 7 consultation with NMFS.

Juvenile winter-run Chinook salmon use the Sacramento River in MU2 and MU3 for rearing and migration and small numbers have also been shown to utilize the lower American River for rearing (Reclamation 2015). Juveniles migrate downstream through the Sacramento River in late fall/early winter. Until 1978 when the State Water Resources Control Board instituted closures of the Delta Cross Channel (DCC) to protect migratory fish, the DCC posed a threat of entrainment into the interior Delta for outmigrating juvenile winter-run Chinook salmon. Following the institution of additional operational criteria for the DCC, it now remains closed from February 1st through May 20th, protecting outmigrating juvenile winter-run Chinook salmon and preventing entrainment into the interior Delta (NMFS 2009a).

Juvenile winter-run Chinook salmon begin to enter the Delta in October and outmigration continues until April. Juvenile outmigration timing is thought to be strongly correlated with winter rain events that result in higher flows in the Sacramento River (del Rosario et al. 2013). Winter-run Chinook salmon use the Delta primarily as a migration corridor as they make their way to Suisun and San Pablo Bays and eventually the Pacific Ocean. Relative abundance in the Delta is inferred through salvage monitoring data, CDFW rotary screw trap sampling, and USFWS Delta Juvenile Fish Monitoring Program (DJFMP) data. Juvenile mortality in the Delta and San Francisco estuary continues to be investigated. A conclusive primary source has yet to be identified, though Delta outflow seems to play an important role (Baker and Morhardt 2001). Predation by piscivorous fish has been at the forefront of this debate and multiple studies have attempted to address the scale at which this source of mortality is affecting the population as a whole (Lindley and Mohr 2003; Demetras et al. 2016).

Status of Sacramento River Winter-run Chinook Critical Habitat in the Action Area

The proposed action area encompasses the entirety of the rangewide riverine and estuarine critical habitat PBFs for winter-run. Wide-spread degradation to these PBFs has had a major contribution to the status of the winter-run ESU, which is at high risk of extinction (NMFS 2016c). PBFs (as discussed in the Section 2.2 *Rangewide Status of the Species*) include: (1) access from the Pacific Ocean to appropriate spawning areas in the upper Sacramento River, (2) the availability of clean gravel for spawning substrate, (3) adequate river flows for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles, (4) water temperatures between 42.5 and 57.5°F (5.8 and 14.1°C) for successful spawning, egg incubation, and fry development, (5) habitat and adequate prey that are not contaminated, (6) riparian habitat that provides for successful juvenile development and survival, and (7) access downstream so that juveniles can migrate from the spawning grounds to San Francisco Bay and the Pacific Ocean.

Passage impediments in the northern region of the Central Valley are largely responsible for isolating the existing population from historical spawning reaches, which occurred upstream of Keswick and Shasta dams and included the upper Sacramento River, McCloud River, Pit River, Fall River and Hat Creek (Yoshiyama et al. 1996; Lindley et al. 2004; NMFS 2014). Due to the installation of Keswick and Shasta dams, the winter-run ESU is now relegated to spawning downstream, in the Sacramento River. The majority of spawning occurs between Red Bluff (Red

Bluff Diversion Dam) and Redding (below Keswick Dam) (Vogel and Marine 1991; NMFS 2014). PBFs #2-4 for this ESU have been degraded in a number of ways. Spatially, the total area of viable spawning habitat has been significantly diminished. Physical features that are essential to the functionality of existing spawning habitat have also been degraded, including loss of spawning gravel and elevated water temperatures during summer months when spawning events occur (NMFS 2014). Degradation of these features is actively mitigated through real-time temperature and flow management at Shasta and Keswick dams (NMFS 2009a) as well as gravel augmentation projects in the affected area, which have been occurring under a multi-year programmatic authority (NMFS 2016d).

PBFs related to the rearing and migration of juveniles and adults have been degraded from their historical condition within the action area as well. Adult passage impediments on the Sacramento River existed for many years at the RBDD and ACID diversion dam (NMFS 2014). However, the RBDD was decommissioned in 2013 providing unimpaired juvenile and adult fish passage and a fish passage improvement project at the ACID dam was completed in 2015, so that adult winter-run Chinook salmon could migrate through the structure at a broader range of flows reaching spawning habitat upstream of that structure.

Juvenile migration corridors are impacted by reverse flows in the Delta that become exacerbated by water export operations at the CVP/SWP pumping plants. This is thought to result in impaired routing and timing for outmigrating juveniles and is evidenced by the presence of juvenile winter-run at the state and Federal fish salvage facilities. Shoreline armoring and development has reduced the quality and quantity of floodplain habitat for rearing juveniles in the Delta and Sacramento River (Williams et al. 2009; Boughton and Pike 2013). Juveniles have access to floodplain habitat in the Yolo Bypass only during mid to high water years, and the quantity of floodplain available for rearing during drought years is currently limited. The Yolo Bypass Restoration Plan includes notching the Fremont Weir, which will provide access to floodplain habitat for juvenile salmon over a longer period (Department of Water Resources and U.S. Bureau of Reclamation 2012).

Central Valley Spring-run Chinook Salmon and California Central Valley Steelhead

Status of Central Valley Spring-run Chinook in the Action Area

The Sacramento River, American River and Sacramento/San Joaquin Delta are included in the action area and aside from the American River (which only currently supports non-natal rearing of juveniles), are extensively used by various life stages of the Central Valley spring-run Chinook salmon ESU. Assessing the temporal occurrence of each life stage of spring-run Chinook salmon in the action area is done through analysis of monitoring data in the Sacramento River and select tributaries; monitoring in the Delta; and salvage data from the Tracy and Skinner fish collection facilities in the south Delta (CVP and SWP) (Table 2-2).

Table 2-2. The Temporal Occurrence of Adult (a) and Juvenile (b) Central Valley Spring-run Chinook Salmon in the Mainstem Sacramento River.

Relative Abundance					Medium				Low			
(a) Adult Migration												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Delta[a]												
San Joaquin Basin												
Sac. River Basin[b,c]												
Sac. River Mainstem[c,d]												
b) Adult Holding[b,c]												
c) Adult Spawning[b,c,d]												
(b) Juvenile Migration												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sac. River at RBDD[d]												
Sac. River at KL[i]												
San Joaquin basin												
Delta[j]												

Sources: a: CDFG (1998); b: Yoshiyama et al. (1998); c: Moyle (2002); d: Myers et al. (1998); e: Lindley et al. (2004); f: CDFG (1998); g: McReynolds et al. (2007); h: Ward et al. (2003); i: Snider and Titus (2000); j: SacTrawl (2015). Note: Yearling spring-run Chinook salmon rear in their natal streams through the first summer following their birth. Downstream emigration generally occurs the following fall and winter. Most young-of-the-year spring-run Chinook salmon emigrate during the first spring after they hatch.

Adult spring-run Chinook salmon enter the San Francisco estuary to begin their upstream spawning migration through MU3 in late January and early February (CDFG 1998). They enter the Sacramento River between March and September, primarily in May and June (Yoshiyama et al. 1998; Moyle 2002). Generally, adult spring-run Chinook salmon are sexually immature when they enter freshwater habitat and must hold in deep pools for up to several months in preparation for spawning (Moyle 2002). The Delta and Sacramento River in MU3, MU2 and MU1 provide a critical migration corridor for spawning adults, allowing them access to spawning grounds upstream.

Monitoring of the Sacramento River mainstem during spring-run Chinook salmon spawning timing indicates that some spawning occurs in the river. Although physical habitat conditions in the accessible upper Sacramento River can support spring-run Chinook salmon spawning and incubation, significant hybridization/introgression with fall-run Chinook salmon due to lack of spatial/temporal separation makes identification of spring-run Chinook salmon in the mainstem very difficult (CDFG 1998). Counts of Chinook salmon redds in MU1 are typically used as an indicator of the Sacramento River spring-run Chinook salmon population abundance. Fewer than fifteen Chinook salmon redds per year were observed in the Sacramento River from 1989 to 1993 based on September aerial redd counts. Redd surveys conducted in September between 2001 and 2011 have observed an average of 36 Chinook salmon redds from Keswick Dam downstream to the RBDD, ranging from 3 to 105 redds; from 2012 to 2015, close to zero redds were observed, except in 2013, when 57 redds were observed in September (CDFW 2015).

Currently, the majority of returning adult spring-run Chinook salmon spawn in the tributaries to the Sacramento River, and described by MU4. MU1 and MU2 of the Sacramento River mainly functions as both rearing habitat for juveniles and the primary migratory corridor for outmigrating juveniles and spawning adults for all the Sacramento River basin populations. The juvenile life stage of CV spring-run Chinook salmon exhibits varied rearing behavior and outmigration timing. Juveniles may reside in the action area for 12–16 months (these individuals are characterized as "yearlings"), while some may migrate to the ocean as young-of-the-year (NMFS 2014).

The Delta is utilized by juveniles prior to entering the ocean. Within the Delta (MU3), juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels, and sloughs (McDonald 1960; Dunford 1975). Juvenile spring-run Chinook salmon use Suisun Marsh extensively as a migratory pathway, though they likely move through quickly based on their size upon entering the bay (as compared to fall-run, which enter this area at a smaller size and likely exhibit rearing behavior prior to continuing their outward migration) (Brandes and McLain 2001; Williams 2012).

An experimental population of spring-run Chinook salmon has been designated under section 10(j) of the ESA in the San Joaquin River from Friant Dam downstream to its confluence with the Merced River (78 FR 79622; December 31, 2013), and spring-run Chinook salmon are currently being reintroduced to the San Joaquin River. The experimental population area in the San Joaquin River is described by MU3 and MU4. A conservation stock of spring-run Chinook is being developed at the San Joaquin River Conservation and Research Facility at Friant Dam and individuals have been released annually since 2014 to the lower San Joaquin River (CDFW 2014). In 2016, the San Joaquin River Restoration Program released 57,320 Feather River Fish Hatchery and 47,560 San Joaquin River Conservation and Research Facility spring-run Chinook salmon juveniles to the San Joaquin River just upstream of the confluence with the Merced River (San Joaquin River Restoration Program 2018).

In addition, observations in the last decade suggest that spring-running populations may currently occur in the Stanislaus and Tuolumne rivers (Franks 2014), tributary rivers to the mainstem San Joaquin River and included in MU3. Although the exact number of spring-running Chinook salmon in the San Joaquin basin is unknown, juvenile and adult spring-run use the portion of the lower San Joaquin River within the Delta as a migratory pathway.

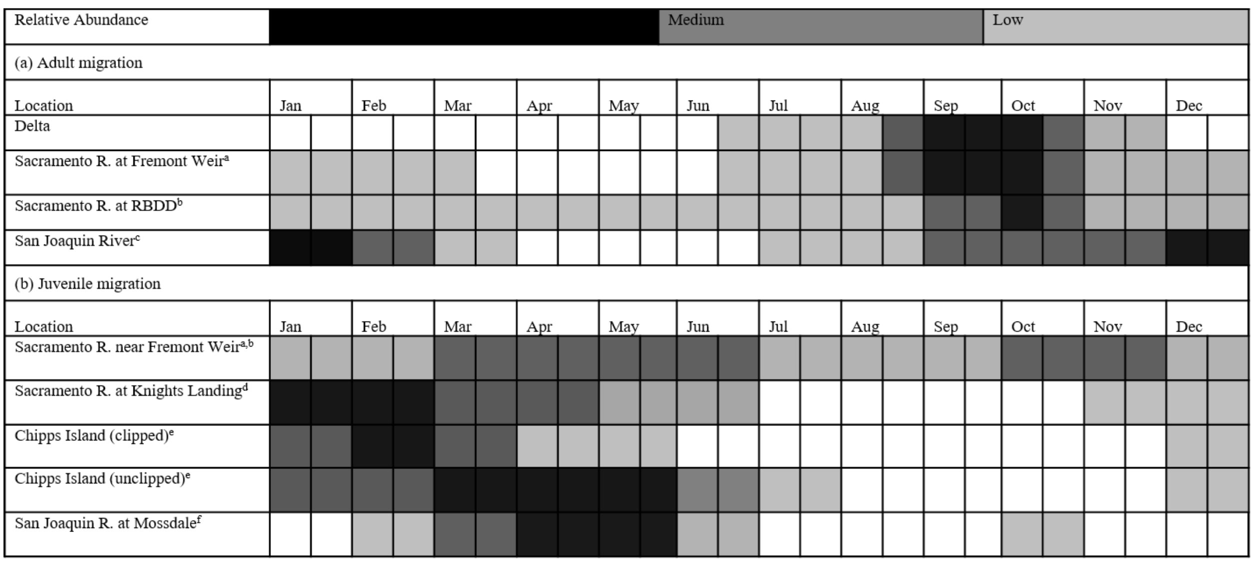
Spring-run Chinook salmon adults are vulnerable to climate change because they over-summer in freshwater streams before spawning in autumn (Thompson et al. 2011). Spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and without cold water refugia (usually input from springs), those tributaries will be more susceptible to impacts of climate change. Even in tributaries with cool water springs, in years of extended drought and warming water temperatures, unsuitable conditions may occur. Additionally, juveniles often rear in their natal stream over the summer prior to emigrating (McReynolds et al. 2007) and would be susceptible to warming water temperatures.

The status of spring-run critical habitat in the action area is discussed below in the discussion of the status of steelhead critical habitat in the action area

Status of California Central Valley Steelhead in the Action Area

CCV steelhead exhibit a similar life history to CV spring-run Chinook and occupy a similar geographic range. As described above, CCV steelhead also extensively use the Sacramento River, and Sacramento/San Joaquin Delta described by MU3, MU2 and MU1, to reach the natal streams of MU4. Assessing the temporal occurrence of each life stage of CCV steelhead in the action area is done through analysis of monitoring data in the Sacramento River and select tributaries; monitoring in the Delta; and salvage data from the Tracy and Skinner fish collection facilities in the south Delta (CVP and SWP) (Table 2-3). The only portion of the action area to contain spawning habitat is the lower American River.

Table 2-3. The Temporal Occurrence of (a) Adult and (b) Juvenile California Central Valley Steelhead at Locations in the Action Area.



Sources: a: Hallock (1957); b: McEwan (2001); c: CDFG Steelhead Report Card Data (2007); d: NMFS analysis of 1998-2011 CDFW data; e: NMFS analysis of 1998-2011 USFWS data; f: NMFS analysis of 2003-2011 USFWS data.

Spawning adults enter the San Francisco Bay estuary and Delta from August to November (with a peak in September (Hallock et al. 1961)). Spawning occurs in a number of tributaries to the Sacramento River, to which the Delta and Sacramento River serve as key migratory corridors (NMFS 2014). Spawning occurs from December to April, with a peak in January through March, in rivers and streams where cold, well-oxygenated water is available (Hallock et al. 1961; McEwan and Jackson 1996; Williams 2006). Adults typically spend a few months in freshwater before spawning (Williams 2006), but very little is known about where they hold between entering freshwater and spawning in rivers and streams. Use of the Delta (MU3) by adults is also poorly understood.

Juvenile CCV steelhead rear in cool, clear, fast-flowing streams and are known to prefer riffle habitat over slower-moving pools (NMFS 2014; Reclamation 2015). The Sacramento River and Delta are likely used primarily as migratory corridors. Little is known about the rearing behavior of juveniles in the Delta; however, they are thought to exhibit short periods of rearing and foraging in tidal and non-tidal marshes and other shallow areas prior to their final entry into the ocean.

The lower American River contains a naturally spawning population of CCV steelhead, which spawn downstream of Nimbus Dam. The dam is an impassable barrier to anadromous fish, isolating historical spawning habitat located in the North, Middle and South forks of the upper American River. In recent years, spawning adults have been observed with intact adipose fins indicating that a portion of the in-river population is of wild origin (Hannon 2013). Juvenile *O. mykiss* (anadromous and resident forms) have been observed to occupy fast-flowing riffle habitat in the lower American River, which is consistent with known life history traits of this species.

Nimbus hatchery, located on the lower American River adjacent to Nimbus Dam, produces the anadromous form of *O. mykiss*; however, steelhead from Nimbus hatchery are not included in the CCV steelhead DPS due to genetic integrity concerns from use of out-of-basin broodstock (71 FR 834; January 5, 2006). To specifically address this issue and in response to RPA Action II.6.1 contained in the NMFS (2009) biological opinion for long-term operations of the CVP/SWP, genetic testing of American River *O. mykiss* population was completed in 2014 to inform the planning for Nimbus Hatchery broodstock replacement that will support the CCV steelhead DPS (NMFS 2016a).

The portion of the lower San Joaquin River within the Delta (MU3) is used by migrating adult CCV steelhead heading upstream to reach spawning areas, and by juveniles migrating downstream to reach rearing grounds (FISHBIO LLC 2012b; FISHBIO LLC 2012c; CDFW 2018).

Although steelhead will experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat, the effects may be even greater in some cases, as juvenile steelhead may rear in freshwater over the summer prior to emigrating as smolts (Snider and Titus 2000). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than salmon (McCullough et al. 2001). McCullough et al. (2001) recommended an optimal incubation temperature at or below 11°C to 13°C (52°F to 55°F), and successful smoltification in steelhead may be impaired by temperatures above 12°C (54°F) (Richter and Kolmes 2005). In some areas, stream temperatures that currently provide marginal habitat for spawning and rearing may become too warm to support naturally spawning steelhead populations in the future.

Status of Central Valley Spring-run Chinook Salmon and California Central Valley Steelhead Critical Habitat in the Action Area

The entirety of designated critical habitat for both CV spring-run Chinook salmon and CCV steelhead is contained within the proposed action area. PBFs for both species are concurrently defined in (70 FR 52488; September 2, 2005) and the following PBFs, in summary, for these species are present in the proposed action area: (1) freshwater spawning sites, (2) freshwater rearing sites, (3) freshwater migration corridors, and (4) estuarine areas.

Historically, both CV spring-run Chinook salmon and CCV steelhead spawned in many of the headwaters and upstream portions of the Sacramento River and San Joaquin River basins described by MU4 and portions of MU3. Similar to winter-run Chinook salmon, passage impediments have contributed to substantial reductions in the populations of these species by isolating them from much of their historical spawning habitat. Naturally spawning spring-run Chinook salmon had been extirpated from the San Joaquin River basin entirely; however, an experimental population has been reintroduced to the river under Section 10(j) of the ESA and spring-running adults have been documented migrating into the San Joaquin tributaries (Franks 2014). The PBF of freshwater spawning sites for these species has been degraded within the action area due to high water temperatures, redd dewatering, and loss of spawning gravel recruitment in reaches below Keswick Dam (Wright and Schoellhamer 2004; Good et al. 2005; NMFS 2009a; Jarrett 2014). These issues are actively addressed by adaptive flow management in both rivers as well as spawning gravel augmentation projects in both reaches (NMFS 2009a; 2015d; 2016e).

Freshwater rearing and migration PBFs have been degraded from their historical condition within the action area. In the Sacramento River and San Joaquin, riverbank armoring has significantly reduced the quantity of floodplain rearing habitat for juvenile salmonids and has altered the natural geomorphology of the river (NMFS 2014). Similar to winter-run Chinook salmon, CV spring-run and CCV steelhead are only able to access large floodplain areas such as the Yolo Bypass under certain hydrologic conditions which do not occur in drier years. However, the Yolo Bypass Restoration Plan includes notching the Fremont Weir, which will provide access to floodplain habitat for juvenile spring-run Chinook salmon and steelhead over a longer period (Department of Water Resources and U.S. Bureau of Reclamation 2012). Levee construction involves the removal of riparian vegetation, resulting in reduced habitat complexity and shading, making juveniles more susceptible to predation. Additionally, loss of riparian vegetation reduces aquatic macroinvertebrate recruitment resulting in decreased food availability for rearing juveniles (Anderson and Sedell 1979; Pusey and Arthington 2003).

The lower Feather and American Rivers have experienced similar losses of rearing habitat; however, projects sponsored by Reclamation are restoring rearing habitat for juvenile CCV steelhead through the creation of side channels and placement of instream woody material (Reclamation 2015).

Within the proposed action area, the estuarine area PBF includes the legal Delta, encompassing significant reaches of the Sacramento and San Joaquin rivers that are tidally influenced (70 FR 52488; September 5, 2005). Estuarine habitat in the Delta is significantly degraded from its historical condition due to levee construction, shoreline development, and dramatic alterations to the natural hydrology of the system due to water export operations (NMFS 2014). Though critical habitat for CV spring-run occurs in the north Delta and not the interior or south Delta, it is thought that some entrainment into the interior Delta may occur during DCC gate openings. However, the 2014 drought year prompted protections for CV spring-run at the DCC (NMFS 2016a). Reverse flows in the central and south Delta resulting from water exports may exacerbate interior Delta entrainment by confounding flow and temperature-related migratory cues in outmigrating juveniles. The presence of these stressors, which cause altered migration timing and routing, degrade critical habitat PBFs related to rearing and migration.

sDPS North American Green Sturgeon

Status of sDPS North American Green Sturgeon in the Action Area

The sDPS green sturgeon exhibit a more complex life history with respect to salmonids and less is known about the ecology and behavior of their various life stages in the action area. Some acoustic telemetry (Kelly et al. 2007; Heublein et al. 2009) and multi-frequency acoustic survey work (Mora et al. 2015) has been done to study adult migration patterns and habitat use in the action area (Delta and Sacramento River). Field surveys have also been conducted on the Sacramento River to study spatial and temporal occurrence of early life stages (Poytress et al. 2010; 2011; 2012; 2013; Poytress et al. 2015). These studies have documented some spatial patterns in spawning events on the upper reaches of the Sacramento River in MU1 and MU2. Although Seesholtz et al. (2015) observed spawning in the Feather River, no known spawning events have been observed in the lower American River or in the portion of the lower San Joaquin River that is included in the Delta (MU3). Additionally, several lab studies have been conducted using early life stages to investigate ontogenic responses to elevated thermal regimes as well as foraging behavior as a function of substrate type (Allen et al. 2006a; Allen et al. 2006b; Nguyen and Crocker 2006; Linares-Casenave et al. 2013). However, due to sparse monitoring data for juvenile, sub-adult and adult life stages in the Sacramento River and Delta, there are significant data gaps to describe the ecology of this species in the action area. It is understood that spawning occurs in the upper reaches of the Sacramento River and Feather River (Seesholtz et al. 2015; Poytress et al. 2015), so the mainstem Sacramento and Delta serve as rearing habitat and a migratory corridor for this species. Some rearing also may occur in the lowest reaches of the lower American River where deep pools occur for rearing of older lifestages (downstream of SR-160 bridge) (Thomas et al. 2013). Information gaps encountered in efforts to summarize information on sDPS green sturgeon life history are often addressed using known information about the nDPS.

Southern DPS green sturgeon spawn primarily in the Sacramento River in the spring and summer, with the farthest upstream spawning event in the Sacramento River documented near Ink's Creek at river km 426 in MU1 (Poytress et al. 2015a). However, Heublein (2009) detected adults as far upstream as river km 451 near Cow Creek, suggesting that their spawning range may extend farther upstream than previously documented. The upstream extent of their spawning range lies somewhere below ACID (RM 206), as that dam impedes passage for green sturgeon in the Sacramento River (Heublein et al. 2009). It is uncertain, however, if green sturgeon spawning habitat exists closer to ACID, which could allow spawning to shift upstream in response to climate change effects. Successful spawning of green sturgeon in other accessible habitats in the Central Valley (i.e., the Feather River) is limited, in part, by late spring and summer water temperatures. Similar to salmonids in the Central Valley, green sturgeon spawning in the major lower river tributaries to the Sacramento River are likely to be further limited if water temperatures increase over time. In a bioenergetics study, 15-19°C was the optimal thermal range for age-0 green sturgeon (Mayfield and Cech 2004). If temperatures in spawning habitat exceed that range in the future, it may reduce the fitness of early life stages.

Table 2-4 The Temporal Occurrence of (a) Spawning Adult, (b) Larval, (c) Young Juvenile, (d) Juvenile, and (e) Sub-adult and Non-spawning Adult Southern DPS Green Sturgeon at Locations in the Action Area. Darker shades indicate months of greatest relative abundance.

(a) Adult-sexually mature (≥145 cm TL females, ≥ 120 cm TL males), including pre- and post-spawning individuals.												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sac River (rkm 332.5-451)												
Sac River (< rkm 332.5)												
Sac-SJ-SF Estuary												
(b) Larval												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sac River (> rkm 332.5)												
(c) Juvenile (≤5 months old)												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sac River (> rkm 332.5)												
(d) Juvenile (≥5 months)												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sac River (< rkm 391)												
Sac-SJ Delta, Suisun Bay												
(e) Sub-Adults and Non-spawning adults												
Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
SAC-SJ-SF Estuary												
Pacific Coast												
Coastal Bays & Estuaries												
Relative Abundance:		= High				= Medium				= Low		

Status of sDPS North American Green Sturgeon Critical Habitat in the Action Area

Critical habitat for sDPS green sturgeon is contained within all of the proposed action area. All PBFs for sDPS green sturgeon critical habitat are present in the action area, except PBFs for nearshore coastal marine areas. The PBFs in the action area include, in summary: (1) food resources; (2) substrate type or size; (3) water flow; (4) water quality; (5) migratory corridor; (6) depth; and (7) sediment quality. These PBFs apply to both riverine and estuarine areas except "substrate type or size," which pertains to spawning habitats and only applies to riverine areas. These PBFs are described in detail in the rangewide status of sDPS green sturgeon in Section 2.2.

The historical spawning range of sDPS green sturgeon is not well known, though they are thought to have spawned in many of the major tributaries of the Sacramento River basin, many of which are isolated due to passage impediments (Beamesderfer et al. 2004). Green sturgeon use the lower Sacramento River for spawning and are known to spawn in its upper reaches between RBDD and Keswick Dam (Poytress et al. 2015a). Similar to the listed salmonid species addressed in this opinion, PBFs related to spawning and egg incubation have been degraded. Changes in flow regimes and the installation of Keswick and Shasta dams have significantly reduced the recruitment of spawning gravel in the upper reaches of the lower Sacramento River. Flow conditions in the Sacramento River have also been significantly altered from their historical condition. The degree to which these altered flow regimes affects outmigration dynamics of juveniles is unknown; however, some suitable habitat exists and spawning events have been consistently observed annually (Poytress et al. 2015a).

PBFs for sDPS green sturgeon in the lower reaches of the Sacramento River and the Delta have also been significantly altered from their historical condition. However, green sturgeon exhibit very different life history characteristics from those of salmonids and therefore use habitat within the proposed action area differently. Green sturgeon are thought to exhibit rearing behavior in the lower reaches of the Sacramento River and the Delta as juveniles and subadults prior to migrating to the ocean, though little is known about the behavior of these lifestages in the Delta (Radtke 1966; NMFS 2015a). Loss of riparian habitat complexity in the Sacramento River and Delta has likely posed less of a threat to green sturgeon because these life stages are benthically oriented. However, it is likely that reverse flows generated by Delta water exports affect the green sturgeon juvenile and subadult life stages to some degree as evidenced by juvenile captures at CVP/SWP salvage facilities during high water years (CDFW 2017; ftp://ftp.dfg.ca.gov/salvage).

Climate Change Impacts

One major factor affecting the rangewide status of the threatened and endangered anadromous fish in the Central Valley and aquatic habitat at large is climate change.

Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen et al. 2000). Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). An altered seasonality results in runoff events occurring earlier in the year due to a shift in precipitation falling as rain rather than snow (Roos 1991; Dettinger et al. 2004). Specifically, the Sacramento River basin annual runoff amount for April-July has been decreasing since about 1950 (Roos 1987; Roos 1991). Increased temperatures influence the timing and magnitude patterns of the hydrograph.

The magnitude of snowpack reductions is subject to annual variability in precipitation and air temperature. The large spring snow water equivalent (SWE) percentage changes, late in the snow season, are due to a variety of factors including reduction in winter precipitation and temperature increases that rapidly melt spring snowpack (Vanrheenen et al. 2004). Factors modeled by Vanrheenen et al. (2004) show that the melt season shifts to earlier in the year, leading to a large percent reduction of spring SWE (up to 100 percent in shallow snowpack areas). Additionally, an air temperature increase of 2.1°C (3.8°F) is expected to result in a loss of about half of the average April snowpack storage (Vanrheenen et al. 2004). The decrease in spring SWE (as a percentage) would be greatest in the region of the Sacramento River watershed, at the north end of the Central Valley, where snowpack is shallower than in the San Joaquin River watersheds to the south.

Projected warming is expected to affect Central Valley Chinook salmon. Because the runs are restricted to low elevations as a result of impassable rim dams, if climate warms by 5°C (9°F), it is questionable whether any Central Valley Chinook salmon populations can persist (Williams 2006). Based on an analysis of an ensemble of climate models and emission scenarios and a reference temperature from 1951–1980, the most plausible projection for warming over Northern California is 2.5°C (4.5°F) by 2050 and 5°C by 2100, with a modest decrease in precipitation (Dettinger 2005). Chinook salmon in the Central Valley are at the southern limit of their range, and warming will shorten the period in which the low elevation habitats used by naturally-producing fall-run Chinook salmon are thermally acceptable. This would particularly affect fish that emigrate as fingerlings, mainly in May and June, and especially those in the San Joaquin River and its tributaries.

Importance of the Action Area for the Survival and Recovery of Listed Fish Species

The action area defined for this Program includes critical habitat designated for all species of ESA-listed fish addressed in this opinion. It includes spawning habitat that is critical for the natural production of these species; rearing habitat that is essential for growth and survival during early life stages and enhances overall productivity and population health; migratory corridors that facilitate anadromous life history strategies; and estuarine habitat that serves as additional rearing habitat and provides a gateway to marine phases of their life cycle.

The NMFS Recovery Plan for the Sacramento River Winter-run Chinook Salmon and Central Valley Spring-run Chinook Salmon ESUs and the California Central Valley Steelhead DPS (NMFS 2014) provides region-specific recovery actions that were identified by NMFS in order to facilitate recovery of these species. Implementation of some of these actions has already begun and more are in the planning phase. The Recovery Plan for sDPS green sturgeon has recently been completed, providing similar information and guidance for green sturgeon (NMFS 2018).

2.5 Effects of the Action

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

Of the proposed restoration project types, several types are expected to have only beneficial effects to listed species. Water conservation projects that occur beyond a diversion point (barrier to fish) do not interact with fish or their habitat and provide benefits by increasing instream water availability. Riparian habitat restoration actions occurring outside of the wetted channel and without disturbance to riparian vegetation are expected to have only beneficial effects to fish and their habitat. Other restoration project types are expected to include adverse effects, with some effect pathways limited to minor effects due to minimization measures, and other effect pathways expected to result in more substantive effects.

2.5.1 Project Effect Pathways with Minimal Effects

The following Program project types are expected to result in some minor adverse effects to listed species or habitat. The effect pathways, such as habitat disturbance from heavy equipment operation, riparian vegetation disturbance, or chemical contamination, are expected to be minimized due to incorporated measures.

Noise, Motion, and Vibration Disturbance from Heavy Equipment Operation

Noise, motion, and vibration produced by heavy equipment operation is 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 to construct cofferdams, is expected to result in negligible effects to listed fishes. Listed salmonids and sturgeon will be able to avoid interaction with instream machinery by temporarily moving 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 fish. With the imposed Program limitations on the use of heavy equipment in the wetted channel and the proposed avoidance and minimization measures, NMFS anticipates a low level of effects within the action area as a result of these activities.

Disturbance to Riparian Vegetation

Impacts to riparian vegetation 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 indirect 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. Most proposed fisheries restoration actions are expected to avoid disturbing riparian vegetation through the proposed conservation measures including the limitations on size of staging area, which will be no larger than 0.50 acres. In general, the restorative nature of these projects is expected and intended to improve habitat conditions for salmon and sturgeon, and thus riparian vegetation disturbance is expected to be avoided, as practicable. However, there may be limited situations where avoidance is not possible. 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.

Herbicide use for removal of invasive plant species could cause short-term impacts to sensitive fish species. Indirect impacts of herbicide use include the potential for short-term loss of shading and habitat provided by the invasive plants. The potential impacts to sensitive species are minimized by using the least toxic herbicides, surfactants, and spray pattern indicators available.

Further, any potential impacts to non-target plant species due to transport from rainfall and wind will be reduced through the use of avoidance and minimization measures. Section 1.3.6, *Protection Measures* provides general minimization measures for the application of herbicides with Section 1.3.5 providing more information on project type-specific measures. With the application of these avoidance and minimization measures, NMFS anticipates minimal loss of riparian vegetation, which is not expected to reduce habitat function within the action area as a result of these activities.

Chemical Contamination from Equipment Fluids

Equipment refueling, fluid leakage, and maintenance activities within and near the stream channel pose some risk of contamination and potential take. 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 fish. However, all fisheries restoration projects under the Program will include the measures outlined in the sections *Measures to Minimize Disturbance from Instream Construction* and *Measures to Minimize Degradation of Water Quality* within Part IX of the CDFW Manual, which address and minimize pollution risk from equipment operation, and *General Measures to Protect Water Quality and Limit Hazardous Materials* found in Section 1.3.6 *Protection Measures*. Therefore, water quality degradation from toxic chemicals associated with habitat restoration projects is not expected to occur.

2.5.2 Project Effects on the Species

Despite the differences in scope, size, intensity, and location of the proposed restoration actions, the potential incidental adverse effects to listed salmonids and sturgeon are expected to result in a more significant temporary effects, including from dewatering, fish relocation, physical disturbance and increased mobilization of sediment. Dewatering, fish relocation, and physical disturbance from structural/material placement are expected to result in direct effects to listed salmonids and sturgeon such that a small percentage of individuals are expected to be injured or killed. The effects from increased sediment mobilization are usually indirect effects because the effects to habitat, individuals, or both, are reasonably certain to occur but are expected later in time.

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 project effects are juvenile salmonids and sturgeon. While migrating adult fish may also be present, their mobility is expected to result in avoidance of the construction areas in most cases. Based on the species life histories detailed in Section 2.2, *Rangewide Status of the Species and Critical Habitat,* a small proportion of salmonids and sturgeon are expected to be present in each project site according to MU below:

Management Unit 1

The in-water work window for MU 1 is defined as October 1 – February 15, for the uppermost portion of the Sacramento River mainstem between Keswick Dam and RKM 391. The MU 1 in-water work window is protective of the "non-migratory" life stages of winter-run Chinook salmon because by October of a given year 100 percent of winter-run Chinook salmon fry will have emerged from the redds and about half of the winter-run Chinook salmon present will have reached the juvenile life stage (Vogel and Marine 1991; Martin et al. 2001). Adult winter-run Chinook salmon presence in MU 1 is expected to be relatively low with only 15-20 percent of the run arriving in the upper Sacramento River by mid-February. A small population of CV spring-run has persisted in MU 1 (NMFS 2016b), and during the in-water work window spring-run Chinook salmon presence would be comprised primarily of eggs and larvae, with an increasing proportion of juveniles in November – February. Adult spring-run Chinook salmon are mostly absent during the MU 1 work window with only about 5 percent having yet to spawn. Steelhead may also be present in MU 1 during the in-water work window as adults, with spawning occurring mid-December - April (peak in February) (McEwan 2001). Green sturgeon juveniles may be present year-round in MU 1 with the downstream migration of juveniles occurring October – February, typically at the same time as winter rain events (NMFS 2015b).

Management Unit 2

The in-water work window for MU 2 is defined as July 15 – October 31 for the portion of the Sacramento River mainstem between RKM 391 and RKM 333. The MU 2 in-water work window is protective of the "non-migratory" life stages of winter-run Chinook salmon as all spawning occurs upriver of the RBDD, and the only exposure would be to a small proportion of juveniles migrating downstream (Martin et al. 2001). A small proportion of CV spring-run Chinook salmon is expected to be present in MU 2 during the in-water work window mostly as adults migrating upriver to spawn (Yoshiyama et al. 1998). Steelhead may also be present in MU 2 (NMFS 2014) but because spawning and incubation occurs outside of the in-water work window, only a small juvenile and moderate adult presence is expected (Hallock 1989; McEwan 2001). For green sturgeon, there is significant overlap with the MU 2 in-water work window and timing of adult and juvenile presence; however, the typical timing of spawning and egg stage presence does not overlap (NMFS 2015b) with the work window.

Management Unit 3

The in-water work window for MU 3 is defined as June 1 through October 31 for the San Joaquin River mainstem and tributaries and the lower Sacramento River and tributaries (with only steelhead spawning). The in-water work window is protective of "non-migratory" life stages for CCV steelhead (such as egg incubation and emergence) for the San Joaquin River tributaries. There are no spawning winter-run Chinook salmon or green sturgeon in MU 3, but green sturgeon are present in the areas during the in-water work window covered by the management unit. And, although observations in the last decade suggest that spring-running populations may currently occur in the Stanislaus and Tuolumne rivers (Franks 2014), spawning has not been documented. Early migrating winter-run Chinook salmon could be present in the lower Sacramento River. According to Vogel and Marine (1991), approximately 20 to 75 percent of juveniles would have left the upper Sacramento river (and entered the lower river) by the end of October. A very low abundance (approximately less than 10 percent) of adult winter-run Chinook salmon would be present in the Sacramento River as 90 percent would have reached RBDD by June. Adult and juvenile green sturgeon may be present anytime of the year in the lower Sacramento River, where there could be some overlap for adults during the in-water work window in the months of June and October. Juvenile green sturgeon rear in the Sacramento River year-round, but overall it is expected that there will be relatively low abundance in the lower Sacramento River for both adults and juvenile green sturgeon. Migrating adult and juvenile CCV steelhead and spring-run Chinook salmon are present in MU 3. Early migratory adult CCV steelhead may begin their upstream migration in the mainstem of both the San Joaquin and Sacramento rivers during the month of October, however the presence of adults is dependent on in-river conditions such as flow and temperature (more likely in wet water years). Therefore, adult presence is expected to be relatively low. In addition, outmigrating juvenile steelhead may be present in the mainstem of both rivers in the month of June if habitat conditions are suitable (likely in wetter water years). The in-water work window avoids upstream migrating adult and outmigrating juvenile spring-run Chinook salmon. However, small numbers of juvenile spring-run Chinook salmon migrants may be passing through MU 3 in the month of June during wet water years.

Management Unit 4

The MU 4 in-water work window is defined as July 15 – September 30, and encompasses spring-run Chinook salmon spawning and holding habitat in the San Joaquin River mainstem and Sacramento River tributaries. These tributaries are outside of the spawning distribution of winter-run Chinook salmon and are therefore protective of that 'species' "non-migratory" life-stages. The migration timing of both spring-run Chinook salmon and steelhead is such that both species are expected to be present as adults during the in-water work window. Adult spring-run holding and spawning overlaps with the in-water work window where peak spawning occurs in September, such that 95 percent of spring-run will have finished spawning by October (Williams 2006). Although information on steelhead spawning is limited, spawning occurs from late December through April, so the "non-migratory" would not be present during the July 15 – September 30 in-water work window (Hallock et al. 1961; Johnson and Merrick 2012). Lastly, green sturgeon are not expected to be found in the tributaries of the Sacramento River, except for the Feather River (Seesholtz et al. 2015), where sexually mature adults are still found through September. Sampling in the mainstem Sacramento River indicates that spawning can occur from late in April through mid-June (Poytress et al. 2015a), therefore, the in-water work window will likely avoid the majority of green sturgeon eggs and larvae in MU 4.

Dewatering

Although most project types include the possibility of dewatering, not all individual project sites will need to be dewatered. 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 maximum length of contiguous stream that can be dewatered is 1,000 feet.

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.

Response and Risk

Stream flow diversion and project work area dewatering are expected to cause temporary loss, alteration, and reduction of aquatic habitat for salmonids and green sturgeon. The extent of temporary loss of juvenile rearing habitat is expected to be minimal because habitat at the restoration sites is typically degraded and the maximum length of contiguous stream that can be dewatered is 1,000 feet per project. These sites will be restored prior to project completion and are expected to be enhanced by the restoration project. Fluctuations in flow outside of dewatered areas are anticipated to be small, gradual, and short-term, which are not expected to result in any behavioral changes to salmonids or green sturgeon.

Effects associated with dewatering activities are expected to be minimized due to the multiple measures that will be used as described in Section 1.3.6 *Protection Measures*. Juvenile salmonids and juvenile green sturgeon that avoid capture and remain in the project work area are expected to 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 1 percent of the total number of salmonids and sturgeon in the project footprint. 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 expected to be present within each project site after relocation activities.

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 and green sturgeon 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 and juvenile green sturgeon that avoid capture in the project work area. 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, and likely less than one percent of the total number of salmonids and sturgeon in the project footprint. Because of their relative mobility, returning or holding adults present within the project vicinity are not expected to be affected by dewatering activities.

Fish Relocation Activities

All project sites that require dewatering will include fish relocation. A qualified biologist will capture and relocate fish away from the restoration project work site to minimize adverse effects of dewatering to listed anadromous fishes. Fish in the immediate project vicinity will be captured by seine, dip net and/or by electrofishing, and will then be transported and released to a suitable instream location.

Response and Risk

Fish relocation activities may injure or kill juvenile salmonids or green sturgeon present in the project 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 sublethal effects including spinal injuries (Habera et al. 1996; Habera et al. 1999; Nordwall 1999; Holliman and Reynolds 2002; Nielsen and Johnson 1983). 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 the saturation concentration. The Program calls for a qualified biologist to relocate fish, following both CDFW and NMFS electrofishing guidelines. Because of these measures, direct effects to, and mortality of, juvenile fishes during capture are expected to be greatly minimized.

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 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 associated with fish relocation activities will be significantly minimized due to the measures that will be utilized, as described in Section 1.3.6 *Protection Measures*, as well as project-specific measures described in Section 1.3.5. It is expected that fish relocation activities associated with implementation of individual restoration projects 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 percent and the mean mortality rates for all sites are less than 1 percent (Collins 2004). A 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 percent across 99 projects that had dewatering during years 2002-2010 (NMFS 2017).

Fish relocation activities are expected to result in a reduction in the survival probability of juvenile salmonids and green sturgeon captured in the project work area. Based on similar projects, it is expected that the number of juveniles that will be killed as a result of capture and handling will be less than 1 percent of the total number of salmonids and sturgeon captured in the project vicinity. Because of their relative mobility, returning or holding adults present in the project vicinity are expected to avoid capture and therefore will not be affected by fish relocation activities.

Physical Disturbance

Most of the proposed restoration project types include the potential for placement of structures in the stream channel causing physical disturbance to the habitat. These structural placements can vary in their size and extent, depending on their restoration objective. Most structural placements are discrete, where only a localized area are expected to be affected.

Response and Risk

Physical disturbance of aquatic habitat may occur during construction activities and the placement of materials, which has the potential to affect the juvenile and adult life stages of salmonids and green sturgeon through displacement and disruption of normal behaviors. Direct injury or death may occur during instream construction activities from the installation of spawning gravel and instream habitat structures, and while grading the riverbed. Materials added to the riverbed and equipment working in the river could injure or kill salmonid and green sturgeon adults and juveniles. 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. Fish relocation is expected to remove most salmonids. Juvenile fish that are not relocated are expected to be killed by either dewatering or structural placement.

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 actively operated or a turbidity plume occurs. Occasionally, feeding juvenile salmonids or sturgeon may be attracted to activity stirring up sediment, but whenever they detect an immediate threat, they are expected to quickly move away (Gregory, 1993; Tuomainen, & Candolin, 2011). Also, the area disturbed by gravel placement or 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 and green sturgeon 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 and green sturgeon from construction is considered extremely unlikely to occur.

Although juveniles are expected to avoid areas where equipment is being used to place or excavate gravel, some juvenile salmonids and juvenile green sturgeon may attempt to find shelter in the substrate and be injured or killed by equipment. Riffle supplementation sites, habitat structure placement, and floodplain and side channel enhancement sites may require the application of gravel 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. Nonetheless, the majority of gravel augmentation 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 (Allen 2000; FISHBIO LLC 2012a). There is limited information regarding habitats occupied by juvenile green sturgeon; however, "habitat preference… in the laboratory suggests that wild juveniles should be in deep pools with some rock structure" (Kynard et al. 2005). Therefore, a low number of juveniles are expected to be injured or killed as a result 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.

Increased Mobilization of Sediment

All project types involving ground disturbance in or adjacent to streams are expected to increase turbidity and suspended sediment levels within the project work site and downstream 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 populations temporarily through reduced availability of food, reduced feeding efficiency, and exposure to sediment released into the water column.

Response and Risk

Short-term increases in turbidity are anticipated to occur during dewatering activities and/or during construction. Research with salmonids has shown that elevated turbidity and suspended sediment levels have the potential to adversely affect all freshwater life stages by clogging or abrading gill surfaces, adhering to eggs, hampering fry emergence (Phillips and Campbell 1961), burying eggs or alevins, scouring and filling in pools and riffles, reducing primary productivity and photosynthesis activity (Cordone and Kelley 1961), and affecting intergravel permeability and dissolved oxygen levels (Zimmermann and Lapointe 2005; Lisle and Eads 1991). Fish behavioral and physiological stress responses include gill flaring, coughing, avoidance, and increased blood sugar levels (Berg and Northcote 1985; Servizi and Martens 1992). Excessive sedimentation over time can cause substrates to become embedded, which reduces successful salmonid spawning and egg and fry survival (Waters 1995). Although small pulses of turbid water can cause salmonids to disperse from established territories moving fish into less suitable habitat and/or increase competition and predation, the proposed protection measures are likely sufficient to avoid substantial impacts. Further, much of the research mentioned above focused on turbidity levels significantly higher than those expected to result from the proposed restoration activities.

The concentrations of sediment and turbidity expected from the proposed restoration activities are not expected to be severe enough to cause injury or death of listed juvenile fishes. Instead, the anticipated minor levels of turbidity and suspended sediment resulting from instream restoration projects are expected to result in temporary behavioral effects. Behavioral effects can often be minimal movements to adjacent areas, or can lead to reduced survival (through higher likelihood of predation) and growth (through reduced feeding). Monitoring of newly replaced culverts in Humboldt County, California, have detailed a range in turbidity changes downstream of replaced culverts following winter storm events (NMFS 2017). 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 or below the 100 to 150 NTU range which could impair feeding (Gregory and Northcote 1993; Harvey and White 2008). Importantly, proposed minimization measures are designed to ensure that future sediment effects from fish passage projects will be small. Compared to other restoration projects, the behavioral effects expected as a result of restoration activities covered under the Program are not likely to be more severe than a short-term reduction in feeding.

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 during culvert construction determined that increased sediment accumulation within the streambed was measurable (relative to control levels within) at a range of 358 to 1,442 meters downstream of the culvert (Lachance et al. 2008). With the measures to minimize sediment mobilization, described in Sections 1.3.5 and 1.3.6, as well as the limits to the temporal and spatial scale of project activities, sediment-related effects are expected to be small. Finally, effects to fish are expected to be short-term, since most project-related sediment will likely mobilize only during the initial high-flow event during the following winter season.

2.5.3 Project Effects to Critical Habitat

Although some habitat restoration projects may cause minor short-term adverse effects to the critical habitat of listed species, all restoration projects are designed and anticipated to improve habitat PBFs resulting in benefits to listed species over the long-term. Furthermore, the restoration sites selected will be of a degraded quality such that the benefit to critical habitat is expected to outweigh any temporary negative impacts. The description below describes both adverse and beneficial impacts to critical habitat of listed species.

Critical habitat PBFs for all listed species may be adversely impacted due to components of restoration activities. These PBFs include spawning, rearing, and migration habitats. The critical habitat designation for green sturgeon identified PBFs considered essential for the conservation of the DPS. Green sturgeon PBFs that may be adversely impacted by restoration actions include water quality, migratory pathway, and sediment quality.

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 projects types, but all are expected to be short-term.

Salmonids

Juvenile rearing sites require cover and cool water temperatures during the summer low flow period. Over-wintering juvenile salmonids require refugia to escape to during high flows in the winter. Temporary adverse effects to rearing habitat PBFs will primarily occur as a result of dewatering the channel and increasing sediment input during instream activities. 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 quality of rearing habitat over the long term. Rearing habitat will be improved by adding complexity that will increase pool formation, cover structures, and velocity refugia.

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 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.

Migratory habitat PBFs are essential for juvenile salmonids outmigrating to the ocean as well as adults returning to their natal spawning grounds. 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.

Green Sturgeon

While limited information is known about the rearing and foraging suitable habitat requirements of Southern DPS green sturgeon, PBFs of water flow, water quality, migratory corridor, and depth, may be affected by construction activities, including localized disturbance to habitat. Project actions may increase sediment, silt, and pollutants, which could adversely affect PBFs including water quality or reduce production of food, such as aquatic invertebrates, for larval and juvenile green sturgeon. However, similar to the discussion of salmonid critical habitat, these adverse effects are expected to be temporary and of short duration.

Also similar to salmonids, green sturgeon require a migratory pathway necessary for the safe and timely passage of juveniles and adults. Migratory habitat PBFs may be affected during the temporary re-routing of the channel during project construction, however any migratory delays will be temporary and likely have little impact on the success of migration.

2.5.4 Beneficial Effects by Project Type

By Program definition a "restoration project" is one that will result in a net increase in aquatic or riparian resource functions and services. All projects are expected to have some long-term benefit to species, primarily through increased quantity or quality of the PBFs of critical habitat. Unlike the assessment of the potential adverse impacts to critical habitat, where effects are described by the construction activities common to multiple project types, the beneficial effects are described specific to individual project types.

Instream Habitat Improvements

Instream habitat structures and improvement projects are expected to 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 are expected to improve the quality of spawning habitat over the long term. Spawning habitat is expected to be improved by reducing the amount of fine sediment that enters the stream in the long term through various types of erosion control. Additionally, gravel augmentation, described in the proposed action, is expected to increase the amount of spawning habitat available.

Fish Passage Improvement

Instream barrier modification for fish passage improvement projects will improve fish passage and increase access to suitable habitat. Long-term beneficial effects are expected to result from these projects by improving passage at sites that are partial barriers, or by providing passage at sites that are total barriers.

Reestablishing the linkages between mainstem migratory habitat and headwater spawning/ rearing habitat will greatly facilitate the recovery of listed species throughout the action area. Improving listed salmonid passage into previously inaccessible upstream habitat is expected to increase reproductive success and ultimately fish population size in watersheds where the amount of high quality freshwater habitat is a limiting factor.

Bioengineered Stream Bank Stabilization

Bioengineered stream bank stabilization projects are expected to reduce sedimentation from bank erosion, decrease turbidity levels, and improve water quality for salmonids and green sturgeon over the long-term. Reducing fine sediment delivery to the stream environment is expected to improve fish habitat and fish survival by increasing fish embryo and alevin survival in spawning gravels, reducing injury to juveniles from high concentrations of suspended sediment, and minimizing the loss of quality and quantity of pools from excessive sediment deposition. In addition, the various proposed streambank restoration activities are expected to enhance native riparian forests or communities, provide increased cover (large wood, boulders, vegetation, and bank protection structures) and a long-term source of all sizes of instream wood.

Fish Screens

Fish screens are commonly used to prevent entrainment of juvenile fish in water diverted for agriculture, power generation, or domestic use. There are at least 3,356 diversions for taking water from the Sacramento and San Joaquin Rivers, their tributaries, and the Delta (Herren and Kawasaki 2001). Nearly all (98.5 percent) of these diversions are "either unscreened or screened insufficiently to prevent fish entrainment" (Herren and Kawasaki 2001). Once entrained, juvenile fish can be transported to less favorable habitat (e.g., a reservoir, lake or drainage ditch) or killed instantly by turbines.

Fish screens substantially decrease juvenile fish loss in stream reaches where surface flow is regularly diverted out of channel. Surface diversions vary widely in size and purpose, from small gravity fed diversion canals supplying agricultural water to large hydraulic pumping systems common to municipal water or power production. All screening projects have similar goals, most notably preventing fish entrainment into intake canals and impingement against the mesh screen. To accomplish this, all screening projects covered by this opinion will follow current guidelines drafted by CDFW and NMFS which outline screen design, construction, placement, and implementation of successful juvenile bypass systems that return screened fish back to the stream channel.

Fish screen projects are expected to reduce the risk for fish being entrained or sucked into irrigation systems. Well-designed fish screens and associated diversions ensure that fish injury or stranding is avoided, and fish are able to migrate through stream systems at the normal time of year.

Riparian Habitat Restoration

Riparian vegetation, particularly shaded riverine aquatic habitat, provides overhead cover and a substrate for food production for juvenile salmonids and green sturgeon. The shade from the vegetation helps to cool water temperatures in the river and seasonally provides insects for fish to forage. Shaded habitat is important to juvenile salmon and steelhead as they migrate down the river to the sea. Terrestrial insects that live on riparian vegetation fall into the river and provide an important food source for fish. Riparian trees and shrubs will eventually end up in the river channel as floods erode the bank or sweep them from the floodplain. Once in the river channel, the stems, trunks, and branches become very important structural habitat components for aquatic life, including fish (Robison and Beschta 1990). Most of the aquatic invertebrates found in the river occur on the woody debris. These invertebrates, in turn, are the primary food of juvenile salmon and steelhead. Large wood affects the hydraulics of flows around it that results in a more complex channel geomorphology and the storage of spawning gravels.

Riparian restoration projects are expected to improve shade and cover, protecting rearing juveniles, reducing stream temperatures, and improving water quality through pollutant filtering. Beneficial effects of constructing livestock exclusionary fencing in or near streams include the rapid regrowth of grasses, shrubs, and other vegetation released from overgrazing and the reduction of excessive nitrogen, phosphorous, and sediment loads in the streams (Line 2003; Brenner 1999). Another documented, beneficial, long-term effect is the reduction in bankfull width of the active channel and the subsequent increase in pool area in streams (Magilligan and McDowell 1997; Corenblit et al. 2007). All are expected to contribute to a more properly functioning ecosystem for listed species by providing additional spawning and cover habitat.

2.6 Cumulative Effects

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

Some continuing non-Federal activities are reasonably certain to contribute to climate effects within the action area. However, it is difficult if not impossible to distinguish between the action area's future environmental conditions caused by global climate change that are properly part of the environmental baseline vs. cumulative effects. Therefore, all relevant future climate-related environmental conditions in the action area are considered in the environmental baseline (Section 2.4).

Unscreened Water Diversions

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found throughout the California Central Valley. Thousands of small and medium-size water diversions exist along the Sacramento River, San Joaquin River, their tributaries, and the Delta, and many of them remain unscreened. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill many life stages of aquatic species, including juvenile listed anadromous species (Mussen et al. 2013; Mussen et al. 2014). For example, as of 1997, 98.5 percent of the 3,356 diversions included in a Central Valley database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001). Most of the 370 water diversions operating in Suisun Marsh are unscreened (Herren and Kawasaki 2001).

Agricultural Practices

Agricultural practices may negatively affect riparian and wetland habitats through upland modifications that lead to increased siltation or reductions in water flow in stream channels flowing into the action area, including the Sacramento River and Delta. Grazing activities from dairy and cattle operations can degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation, as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which then flow into receiving waters. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may disrupt various physiological mechanisms and may negatively affect reproductive success and survival rates of listed anadromous fish (Scott and Sloman 2004).

Increased Urbanization

According to the Delta Protection Commission's Economic Sustainability Plan, the population within the Legal Delta experienced a 56 percent increase from 1990 to 2010, while California as a whole experienced a 25 percent increase over that time period (Delta Protection Commission 2012). The prediction of continued increased urbanization and housing developments will likely impact habitat by altering watershed characteristics and changing both water use and stormwater runoff patterns. Increased growth will place additional burdens on resource allocations, including natural gas, electricity, and water, as well as on infrastructure such as wastewater sanitation plants, roads and highways, and public utilities. Some of these actions, particularly those which are situated away from waterbodies, will not require Federal permits, and thus will not undergo review through the ESA section 7 consultation process with NMFS.

Increased urbanization is also expected to result in increased recreational activities in the region. Among the activities expected to increase in volume and frequency is recreational boating. Boating activities typically result in increased wave action and propeller wash in waterways. This potentially will degrade riparian and wetland habitat by eroding channel banks and mid-channel islands, thereby causing an increase in siltation and turbidity. Wakes and propeller wash also churn up benthic sediments thereby potentially resuspending contaminated sediments and degrading areas of submerged vegetation. This, in turn, would reduce habitat quality for the invertebrate forage base required for the survival of juvenile salmonids and green sturgeon moving through the system. Increased recreational boat operation is anticipated to result in more contamination from the operation of gasoline and diesel powered engines on watercraft entering the associated water bodies.

Wastewater Treatment Plants

Two wastewater treatment plants (one located on the Sacramento River near Freeport and the other on the San Joaquin River near Stockton) have received special attention because of their discharge of ammonia. The Sacramento Regional Wastewater Treatment Plan (SRWTP), in order to comply with Order no. R5-2013-0124 of the Central Valley Regional Water Quality Control Board (CVRWQCB), has begun implementing compliance measures to reduce ammonia discharges. Construction of treatment facilities for three of the major projects required for ammonia and nitrate reduction was initiated in March 2015 (Sacramento Regional County Sanitation District 2015). Order no. R5-2013-0124, which was modified on October 4, 2013, by the CVRWQCB, imposed new interim and final effluent limitations, which must be met by May 11, 2021 (CVRWQCB 2013). By May 11, 2021, the SRWTP must reach a final effluent limit of 2.0 milligrams per liter (mg/L) per day from April to October and 3.3 mg/L per day from November to March (CVRWQCB 2013). However, the treatment plant is currently releasing several tons of ammonia in the Sacramento River each day.

In 2013, EPA published revised national recommended ambient water quality criteria for the protection of aquatic life from the toxic effects of ammonia. However, few studies have been conducted to assess the effects of ammonia on Chinook salmon, steelhead, or sturgeon. Studies of ammonia effects on various fish species have shown numerous effects including membrane transport deficiencies, increases in energy consumption, immune system impairments, gill lamellae fusions deformities, liver hydropic degenerations, glomerular nephritis, and nervous and muscular system effects leading to mortality (Connon et al. 2011). Additionally, a study of Coho salmon and rainbow trout exposed to ammonia showed a decrease in swimming performance due to metabolic challenges and depolarization of white muscle (Wicks et al. 2002).

Changes in Location, Volume, Timing, and Method of Delivery for Non-CVP and Non-SWP Diversions

Changes in location, volume, timing, and method of delivery for non-Central Valley Project and non-State Water Project diversions not previously included in the section 7 Effects Analysis of the 2008 biological assessment for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project may be fully or partially implemented without Federal consultation. While the details of implementation are not certain, changes may be expected to occur due to:

- Implementation of the California Sustainable Groundwater Management Act that requires development and implementation of Groundwater Sustainability Plans;
- Implementation of the California Senate Bill X7-7 provisions which require the state to achieve a 20 percent reduction in urban per capita water use by December 31, 2020;
- Implementation of the California 2009 Delta Reform Act (implementation of portions of the Delta Reform Act also is part of the California Water Action Plan);
- Implementation of the California Water Action Plan released by Governor Jerry Brown in January 2014, specifically, for provisions of the plan that would not necessarily require separate environmental documentation and consultation for related Federal actions.

NMFS does not have information on the specific impacts from these programs to listed fish species or critical habitat at this time; thus, NMFS cannot determine the specific impacts of these programs. NMFS expects that habitat restoration activities under the California Water Action Plan would have short-term effects (sedimentation, turbidity, acoustic noise, temporary habitat disturbance) similar to effects discussed in this opinion for similar habitat restoration project types (see Section 1.3.5 *Project Types and Prohibited Activities*). In general, NMFS expects that implementation of these programs will improve habitat conditions for listed fish into the future through the increased availability of instream flows and Delta habitat restoration.

Other Activities

Other future, non-Federal actions within the action area that are likely to occur and may adversely affect Chinook salmon, steelhead, and green sturgeon and their critical habitat include: the dumping of domestic and industrial garbage that decreases water quality; oil and gas development and production that may affect aquatic habitat and may introduce pollutants into the water; and state or local levee maintenance that may also destroy or adversely affect habitat and interfere with natural, long term habitat-maintaining processes.

Power plant cooling system operations can also affect aquatic habitat. Contra Costa Power Plant, which was owned and operated by NRG Delta, LLC, was retired in 2013 and replaced with the

Marsh Landing Generating Station. The Pittsburg Generating Station (PGS) remains in operation and consists of seven once-through cooling systems, four of which have been retired, one of which is in the process of being retired, and two of which remain in operation. The once-through cooling system intake process can cause the impingement and entrainment of marine animals, kill organisms from all levels of the food chain, and disrupt the normal processes of the ecosystem. Additionally, the plant can discharge heated water that can reach temperatures as high as 100°F into the action area. This sudden influx of hot water can adversely affect the ecosystem and the animals living in it (San Francisco Baykeeper 2010).

On May 4, 2010, the SWRCB adopted a Statewide Policy on the Use of Coastal and Estuarine Water for Power Plant Cooling under Resolution No. 2010–0020, which required existing cooling water intake structures to reflect the best technology available for minimizing adverse environmental impacts (SWRCB 2010). The PGS was required to submit an implementation plan to comply with this policy by December 31, 2017, and the PGS chose to comply by retrofitting two of the existing units and retiring one unit (GenOn Delta LLC 2011).

2.7 Integration and Synthesis

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

2.7.1 Cumulative Effects

The Cumulative Effects section (Section 2.6) of the opinion describes future state, tribal, local, or private actions that are reasonably certain to occur in the action area. For this opinion, these include unscreened water diversions and the point and non-point source chemical contaminant discharges related to agricultural and urban land use. These actions typically result in habitat fragmentation and degradation of habitats that incrementally reduces the carrying capacity of the rearing and migratory corridors found within the action area. Cumulative effects also include the implementation of changes in state law and the California Water Action Plan as outlined in Section 2.6 *Cumulative Effects*, which could change the location, volume, timing, and method of delivery for non-Central Valley Project and non-State Water Project diversions not previously included in the section 7 Effects Analysis of the 2008 biological assessment for the Coordinated Long-Term Operation of the Central Valley Project and State Water Project (Reclamation 2008) which may be fully or partially executed without Federal consultation. The effect of these actions, while uncertain, are expected to provide greater oversight of water use and associated water quality which would improve conditions for aquatic species in the action area.

2.7.2 Status of the Species and Environmental Baseline

The status of the species and environmental baseline for species have been described in Sections 2.2 and 2.4, respectively. Critical to the integration and synthesis of effects are the VSP parameters of abundance, productivity, spatial structure, and diversity. Because these parameters are consistent with the "reproduction, numbers, or distribution" criteria found within the regulatory definition of jeopardy (50 CFR 402.02), the VSP parameters are used as surrogates for the jeopardy criteria. These VSP parameters are used to establish the reference condition of a population in the status of the species and environmental baseline and where an appreciable change to these parameters is used to assess the risk to the population and the risk to the ESU.

Sacramento River Winter-run Chinook Salmon

As described in Section 2.2, *Rangewide Status of the Species and Critical Habitat*, the SR winter-run Chinook salmon ESU was first listed as threatened in 1989 (54 FR 32085), reclassified as endangered in 1994 (59 FR 440), and then reaffirmed as endangered in 2005 (70 FR 37160).

Based on the most recent status review, several criteria qualify the one remaining population of winter-run Chinook salmon as being at moderate risk of extinction, though only one criterion is required. However, because this ESU is limited to the single population that spawns below Keswick Dam, the winter-run Chinook salmon ESU is at high risk of extinction in the long-term according to criteria in Lindley et al. (2007). Recent trends in those criteria are:

(1) continued low abundance;

(2) a negative growth rate over 6 years (2006–2012), which is two complete generations;

(3) a significant rate of decline since 2006;

(4) increased hatchery influence on the population; and

(5) increased risk of catastrophe from oil spills, wild fires, or extended drought (i.e., realization of effects of climate change).

The most recent 5-year status review (NMFS 2016c) on winter-run Chinook salmon concludes that the extinction risk of this ESU has increased since the last status review largely due to extreme drought and poor ocean conditions.

Central Valley Spring-run Chinook Salmon

The Central Valley Spring-run Chinook Salmon ESU was first listed as threatened in 1999 (64 FR 50394) and then reaffirmed in 2005 70 FR 37160), with the experimental, non-essential population designated in 2013 (78 FR 79622).

Overall, because the populations in Butte, Deer and Mill creeks are the best trend indicators for ESU viability, we can evaluate risk of extinction based on VSP parameters in these watersheds. Lindley et al. (2007) indicated that the spring-run Chinook salmon populations in the Central

Valley had a low risk of extinction in Butte and Deer creeks, according to their population viability analysis (PVA) model and other population viability criteria (i.e., population size, population decline, catastrophic events, and hatchery influence, which correlate with VSP parameters abundance, productivity, spatial structure, and diversity). The Mill Creek population of spring-run Chinook salmon was at moderate extinction risk according to the PVA model, but appeared to satisfy the other viability criteria for low-risk status. However, the CV spring-run Chinook salmon ESU failed to meet the "representation and redundancy rule" since there are only demonstrably viable populations in one diversity group (northern Sierra Nevada) out of the three diversity groups that historically contained them, or out of the four diversity groups as described in the NMFS Central Valley Salmon and Steelhead Recovery Plan. Over the long term, these three remaining populations are considered to be vulnerable to catastrophic events, such as volcanic eruptions from Mount Lassen or large forest fires due to the close proximity of their headwaters to each other. Drought is also considered to pose a significant threat to the viability of the spring-run Chinook salmon populations in these three watersheds due to their close proximity to each other. Therefore, the extinction risk for the CV spring-run Chinook salmon ESU remains at moderate risk of extinction (NMFS 2016b). Based on the severity of the drought and the low escapements as well as increased pre-spawn mortality in Butte, Mill, and Deer creeks in 2015, there is concern that these CV spring-run Chinook salmon strongholds will further deteriorate into high extinction risk based on the population size or rate of decline criteria (NMFS 2016b). The most recent years of monitoring data provide validity to this concern as the 2017, 3-year running average escapement, was the lowest it has been in over 30 years for Mill and Deer Creeks combined (CDFW 2018).

California Central Valley Steelhead

The California Central Valley Steelhead DPS was first listed as threatened in 1998 (63 FR 13347) and then reaffirmed as threatened in 2006 (71 FR 834).

All indications are that natural origin CCV steelhead abundance, and the proportion of natural origin steelhead in the DPS, has continued to decrease over the past 25 years (NMFS 2016a). Hatchery production and returns are dominant over natural origin steelhead, with hatchery releases (100 percent adipose fin-clipped fish since 1998) remaining relatively constant over the past decade, but the proportion of adipose fin-clipped hatchery smolts to unclipped naturally produced smolts has steadily increased over the same period.

Using data through 2005, Lindley et al. (2007) found that data were insufficient to determine the status of any of the naturally-spawning populations of CCV steelhead, except for those spawning in rivers adjacent to hatcheries, which were likely to be at high risk of extinction due to extensive spawning of hatchery-origin fish in natural areas. And although the widespread distribution of natural origin steelhead in the Central Valley provides the spatial structure necessary for the DPS to survive and avoid localized catastrophes, most natural origin CCV steelhead populations are very small and may lack the resiliency to persist for protracted periods if subjected to additional stressors. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery origin steelhead relative to natural origin fish. In consideration of these conditions, the most recent status review of the CCV steelhead DPS (NMFS 2016a) found that the status of the DPS has not changed since the 2011 status review.

Green Sturgeon

The Green Sturgeon sDPS was listed as threatened in 2006 (71 FR 17757).

The viability of sDPS green sturgeon is constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into a limited section of the river. And although the population structure of sDPS green sturgeon is still being refined, it is currently believed that only one population of sDPS green sturgeon exists. Lindley et al. (2007), in discussing SR winter-run Chinook salmon, stated that an ESU represented by a single population at moderate risk of extinction is at high risk of extinction over the long run. This concern applies to any DPS or ESU represented by a single population, and if this were to be applied to sDPS green sturgeon directly, it could be said that sDPS green sturgeon face a high extinction risk. However, NMFS concludes that the extinction risk is moderate because, although threats due to habitat alteration are thought to be high and indirect evidence suggests a decline in abundance, there is much uncertainty regarding the scope of threats and the accuracy of population abundance indices (NMFS 2010a).

Summary of Proposed Action Effects on the Species

Restoration projects authorized under the Program are for the purpose of restoring anadromous fish habitat. As such, proposed projects under the Program are expected to result in benefits to listed species. As described above, some projects include components that are expected to result in minor or temporary adverse effects (e.g., sediment mobilization), while other components are expected to result in more substantive adverse effects (e.g., relocation activities). NMFS anticipates less frequent substantive adverse effects resulting in short-term behavioral changes, or resulting in small numbers of juvenile salmon, steelhead, and/or green sturgeon to be injured or killed at each individual restoration project work site. This includes those fish present in the project work area, that will be subject to capture, relocation, and related stresses. Any unintentional mortalities of listed species during dewatering and fish relocation activities are expected to occur exclusively at the juvenile stage. More frequent and minor effects are expected to occur to listed anadromous fish present during project construction, including disturbance, and displacement to adjacent habitat.

Short-term impacts to listed species from restoration activities will be minimal and localized at each project site. The duration and magnitude of direct effects associated with implementation of individual restoration projects to listed salmonids and green sturgeon are expected to be significantly minimized due to the minimization measures that will be used during implementation. The temporal and spatial limits (i.e., MU-specific work-windows) included in the proposed action will minimize effects to the most vulnerable non-migratory life stages, thereby avoiding the most significant impacts to the productivity and spatial structure VSP parameters for an ESU/DPS. Further, NMFS anticipates the effects of individual restoration projects will not reduce the number of returning listed salmonid adults which would otherwise affect the abundance VSP parameter for a species. Even though salmonid and sturgeon numbers are dramatically reduced from historical abundance in the affected ESU and DPSs, juvenile losses are expected to be very small compared to the total number of juveniles that continue to rear each year and in the action area. The small losses that do occur are unlikely to affect the VSP parameters at the population level in a watershed or at the level of the ESU/DPS. Lastly, the low numbers of juvenile fish anticipated to be captured, injured or killed will be dispersed over a large geographic area and therefore reduce the effect to the spatial structure and diversity VSP parameters by not concentrating all effects on any one population.

Given that the VSP parameters for each ESU/DPS are not expected to be significantly reduced by the proposed action, NMFS has determined the effects of the action, when added to the environmental baseline and cumulative effects, are not expected to appreciably reduce the numbers, distribution or reproduction of salmon, steelhead and/or green sturgeon within each watershed where restoration projects occur, or within their respective ESU/DPS. This is based on the Program's numeric limit on concurrent projects each year (maximum of 60), that projects are spaced across a large geographic area, and that projects have required minimization and avoidance measures that result in short-term effects from restoration project construction. All of the restoration projects are intended to restore degraded salmonid and sturgeon habitat and improve instream cover, pool habitat, and spawning gravel; remove barriers to fish passage; and reduce or eliminate erosion and sedimentation impacts. These restoration projects are selected based the priorities set forth in current recovery plans and in close coordination with CDFW and NMFS staff biologists working in watershed recovery areas. Projects are generally prioritized based on the population structure with priority given to independent populations that are a priority for achieving viability across ESUs and DPSs. With improvements in population viability these populations are expected to become more resistant and resilient to climate change impacts (which are likely to increase in the action area and across the ESUs and DPSs) as the Program continues into the future. As such, the Program as is expected to result in an increase of listed species survival, and be an aid to recovery.

2.7.3 Status of Critical Habitat and Environmental Baseline

Currently accessible salmonid and sturgeon habitat throughout the action area has been severely degraded, and the condition of designated critical habitats, specifically their ability to provide for long-term salmonid and sturgeon conservation, has also been degraded from conditions known to support viable populations. Intensive land and stream manipulation during the past century (e.g., logging, agricultural/livestock development, mining, urbanization, and river dams/diversion) has modified and eliminated much of the historic anadromous fish habitat in the Central Valley of California. For salmonids the status of critical habitat in the environmental baseline has many PBFs that are impaired, to the extent of limiting the availability (and accessibility) of high quality habitat. For example, the critical habitat currently includes a number of features that reduce the quality of migratory corridors for juveniles including passage impediments, altered Delta flows, and a lack of floodplain habitat. In addition, current water operations can limit the spatial extent of cooler-water habitat downstream of dams, which reduces the available habitat for spawning and egg incubation (based on water temperature suitability). Likewise, many of the PBFs of sDPS green sturgeon designated critical habitat are currently degraded or impaired and provide limited high quality habitat. Features that lessen the quality of migratory corridors and rearing habitat for juvenile green sturgeon include unscreened or inadequately screened diversions, altered flows in the Delta, and the presence of contaminants in sediment. Although the current conditions of salmonid and sturgeon critical habitat are significantly degraded, the remaining habitat for spawning and egg incubation, migratory corridors, and rearing is considered to have high intrinsic value for the conservation of the species.

2.7.4 Summary of Proposed Action Effects to Critical Habitat

NMFS expects minor, short-term impacts to listed salmonid and sturgeon designated critical habitat associated with the projects implemented each year under the Program. However, projects implemented are expected to provide long-term improvements to anadromous fish habitat in the Central Valley. NMFS also anticipates that the additive, beneficial effects to instream salmonid and sturgeon habitat conditions would accrue over multiple generations of salmon and sturgeon, which will improve the condition of local populations into the future. As identified in the NMFS Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014), "the restoration of functioning, diverse and interconnected habitats is necessary for a species to be viable." Impediments to species recovery, such as habitat loss and fragmentation caused by barriers to migration are expected to be reduced or reversed as a result of implementing the proposed action.

In addition to decreasing threats to recovery, the restoration of specific PBFs of habitats is expected to result in improvements to adult spawning success, juvenile survival, and smolt outmigration, which will in turn promote improved VSP parameters of abundance, productivity, spatial structure, and diversity for individual populations. As PBFs of critical habitat improves, we expect individual population viability to improve, and the viability of the ESUs and DPSs are expected to improve as well. Based on our analysis, NMFS concludes that the proposed action is not expected to appreciably diminish, rather it is expected to increase the value of designated critical habitat for the conservation of listed salmon and sturgeon species in the Central Valley.

2.8 Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent activities, and cumulative effects, it is NMFS' opinion that the proposed action is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, Southern DPS of North American green sturgeon or destroy or adversely modify designated critical habitat for these listed species.

2.9 Incidental Take Statement

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

2.9.1 Amount or Extent of Take

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

Under the Program, incidental take is expected to occur during dewatering, fish relocation activities, and the placement of structures or materials in the wetted stream channel causing physical disturbance to the habitat at individual project sites. In stream reaches where anadromous fish are expected to be present during construction, efforts will be made to design construction activities to maintain continued volitional fish passage through the construction area by avoiding the complete dewatering of the channel cross-section. At project sites where the entire channel cross-section must be dewatered, the maximum length of contiguous stream that can be dewatered is 1,000 feet. In estimating take for projects not requiring dewatering, the take associated with physical disturbance is expected to be no greater than the number of individuals that would otherwise be killed by desiccation after the reach was dewatered. Given this expectation, the take associated with physical disturbance is considered equivalent to the take associated with dewatering, and therefore the estimate of the number of fish harmed by dewatering activities also applies to the take associated with physical disturbance.

Given the precedent of other programmatic NMFS opinions for restoration in the coastal regions (NMFS Arcata and Santa Rosa Offices), and the similarity of fish capture and relocation methods to be employed in the action area for the Program, we assume that on average, fish will be injured or killed on a per-project basis similar to that experienced during implementation of Arcata and Santa Rosa Office opinions (NMFS 2012; 2016). Using the fish mortality data recorded for all projects from 2009 – 2017 (NMFS 2017) with an observed 3 percent mortality based on rate of fish capture at restoration sites (Collins 2004); we back calculate the estimated number of fish captured per project (restoration project practitioners were only required to report mortalities). For the period of 2009 – 2017, a total of 1,126 Chinook killed equates to an estimated 37,533 fish captured across 452 restoration projects; 1,546 steelhead killed equates to an estimated 51,533 fish captured during 536 restoration projects; and 1 green sturgeon killed equates to an estimated 33 fish captured during 23 restoration projects. On a per-project basis, the estimated number of Chinook captured would be 83; steelhead 96; and green sturgeon 1.

NOAA RC program data (from the Arcata and Santa Rosa Offices) as well as data from CDFW's Fisheries Restoration Grant Program (FRGP) annual reports to NMFS show that approximately 10 percent of restoration projects involve the placement of structures or materials in the wetted channel or dewatering. We assume this percentage is a reasonable estimate of the frequency of physical disturbance and dewatering expected for projects in the action area of the Program. Given a 10 percent physical disturbance and dewatering rate and a maximum of 60 concurrent projects per year under this Program, an estimated 6 projects per year would involve physical disturbance and dewatering.

Based on the above assumptions, the proposed action will result in incidental take of listed juvenile Chinook salmon, juvenile steelhead, and green sturgeon during the 10-year timeframe of this programmatic opinion. Chinook salmon, steelhead, and green sturgeon will be captured, injured and/or killed by the placement of structures or materials in the wetted channel, dewatering of the channel or fish relocation activities at project sites. Incidental take is primarily expected to be in the form of capture during fish relocation activities.

For each of the Chinook salmon DPSs, NMFS expects no more than 498 juveniles will be captured annually, of which 15 will be injured and 15 will be killed. NMFS expects no more than 576 juvenile California Central Valley DPS steelhead will be annually captured, of which 17 will be injured and 17 will be killed. Given the in-water work windows and other impact and avoidance measures, as well as the limited numbers of green sturgeon within the action area, no more than 6 green sturgeon are expected to be captured annually, of which no more than 1 would be injured and no more than 1 would be killed. If the annual estimates of take per species described is exceeded by more than 10 percent in a single year, or if exceeded by any amount in three consecutive years, the proposed action will be considered to have exceeded anticipated take levels.

2.9.2 Effect of the Take

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

2.9.3 Reasonable and Prudent Measures

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

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead DPS, and Southern DPS of North American green sturgeon:

1. Measures shall be taken to minimize the amount or extent of incidental take of listed salmonids and green sturgeon resulting from the placement of structures or materials in the wetted channel, dewatering of the channel, and the capture and relocation of fish.

2. Measures shall be taken to ensure that individual restoration projects authorized annually through the Program will minimize take of listed salmonids and green sturgeon, will monitor and report take of listed salmonids and green sturgeon, and where feasible, obtain specific project information to better assess the effects and benefits of salmonid restoration projects authorized through the Program.

3. Measures shall be taken to handle or dispose of any individual Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead DPS, or Southern DPS of North American green sturgeon actually killed.

2.9.4 Terms and Conditions

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

1. The following terms and conditions implement Reasonable and Prudent Measure No. 1, which states that measures shall be taken to minimize the amount or extent of incidental take of listed salmonids and green sturgeon resulting from the placement of structures or materials in the wetted channel, dewatering of the channel, and the capture and relocation of fish:

    a. If the annual estimates of take per species described above is exceeded by 10 percent or more in any single year, or if exceeded by any amount in three consecutive years, NOAA RC, the Corps, and USFWS will develop an adaptive management plan in coordination with NMFS to incorporate additional minimization measures in project plans as needed. At a minimum, an adaptive management plan will consider reducing the total number of concurrent projects covered by the Program to a number fewer than that which would result in the expected level of take per species described above[2].

    b. Any injuries or mortality from a project-specific fish relocation site that exceeds three percent of captured fish for any listed species shall be reported to the nearest NMFS office within 48 hours and relocation activities shall cease until a NOAA RC biologist is on site to supervise the remainder of relocation activities.

2. The following terms and conditions implement Reasonable and Prudent Measure No. 2, which states that measures shall be taken to ensure that individual restoration projects authorized annually through the Program will minimize take of listed salmonids and green sturgeon, will monitor and report take of listed salmonids and green sturgeon, and where feasible, obtain specific project information to better assess the effects and benefits of salmonid restoration projects authorized through the Program.

    a. In order to monitor the impact and track incidental take of listed salmonids, the NOAA RC which is responsible for administration and oversite of the Program, must annually submit to NMFS a report of the previous year's restoration activities. The annual report shall include a summary of the specific type and

[2] If take in a single year is exceeded by 15 percent, an adaptive management plan would consider reducing the number of concurrent projects covered by the Program to 51 projects (15 percent fewer than 60). If take is exceeded in three consecutive years, such that the average exceedance for the three years was 7 percent, an adaptive management plan would consider reducing the number of concurrent projects covered by the Program to 55 projects (7 percent fewer than 60, rounded up).

location of each project, stratified by individual project, 5th field HUC and affected species and ESU/DPS.:

- Summary narrative detailing fish relocation activities, including the number and species of fish relocated and the number and species injured or killed. Any capture, injury, or mortality of adult salmonids or half-pounder steelhead will be noted in the monitoring data and report. Any injuries or mortality from a fish relocation site that exceeds 3 percent of the affected listed species shall have an explanation describing why.

- The total number and species of fish captured and the total number and species injured or killed during the previous three years of Program implementation. If the annual estimates of take per species is exceeded by more than 10 percent in a single year, or if exceeded by any amount in three consecutive years, the annual report will also outline steps necessary to develop an adaptive management plan for the Program.

- The number and type of instream structures implemented within the stream channel.

- The length of streambank (feet) stabilized or planted with riparian species.

- The number of culverts replaced or repaired, including the number of miles of restored access to unoccupied salmonid habitat.

- The distance (feet) of aquatic habitat disturbed at each project site.

This report shall be submitted annually by March 1 to the NMFS Central Valley Office:

National Marine Fisheries Service
Central Valley Office Supervisor
650 Capitol Mall, Suite 5-100
Sacramento, California 95814

3. The following terms and conditions implement Reasonable and Prudent Measure No. 3, which states that measures shall be taken to handle or dispose of any individual Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead DPS, or Southern DPS of North American green sturgeon actually killed.

   a. All steelhead, Chinook salmon, and green sturgeon mortalities must be retained, placed in an appropriately sized whirl-pak or zip-lock bag, labeled with the date and time of collection, fork length, location of capture, and frozen as soon as possible. Frozen samples must be retained until specific instructions are provided by NMFS.

2.10 Conservation Recommendations

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

NMFS has no conservation recommendation for this proposed action.

2.11 Reinitiation of Consultation

This concludes formal consultation for the NOAA Restoration Center's Program to Facilitate Implementation of Restoration Projects in the Central Valley of California.

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

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

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

This analysis is based, in part, on the EFH assessment provided by the NOAA Restoration Center, the U.S. Fish and Wildlife Service and the U.S. Army Corps of Engineers, and descriptions of EFH for Pacific Coast salmon (Pacific Fishery Management Council [PFMC] 2014), and Pacific Coast groundfish (PFMC 2005), and contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1 Essential Fish Habitat Affected by the Project

Pacific coast salmon, and Pacific groundfish, may be adversely affected by the proposed action. Specific habitats identified in PFMC (2014) for Pacific coast salmon include Habitat Areas of Particular Concern (HAPCs), identified as: 1) complex channels and floodplain habitats; 2) thermal refugia; and 3) spawning habitat. HAPCs for salmon also include all waters and substrates and associated biological communities falling within the habitat areas defined above. Essentially, all Chinook habitat located within the proposed action area are considered HAPC as defined in PFMC (2014). These HAPC EFH areas include current and historical distribution of salmon in California obtained from Calfish (2012) and NMFS (2005) (as cited in PFMC 2014). Estuaries in the action area that may be adversely affected for Pacific groundfish (PFMC 2005), are those existing in the western-most region of the Delta. This estuarine area is potential habitat for eelgrass (*Zostera marina*), which is also designated as EFH-HAPCs for groundfish.

Restoration activities typically occur in watersheds and estuaries subjected to significant levels perturbation that have reduced the quality and quantity of instream habitat available for native anadromous fish. Types of permitted projects covered by the Program include: instream habitat improvement, fish passage improvement (including construction of new fish ladders/fishways and maintenance of existing ladders), bank restoration, riparian restoration, upslope restoration, and stream or estuary restoration. The majority of the actions considered in the accompanying opinion follow those described in: (1) California Department of Fish and Game's (CDFG) *California Salmonid Stream Habitat Restoration Manual, Third Edition, Volume II* with three new chapters *(Part IX: Fish Passage Evaluation at Stream Crossings, Part X: Upslope Assessment and Restoration Practices, and Part XI: Riparian Habitat Restoration*) added in 2003 and 2004 (Flosi et al. 2010), (2) NMFS' *Guidelines for Salmonid Passage at Stream Crossings* (NMFS 2000), and (3) NMFS' *Fish Screening Criteria for Anadromous Salmonids* (NMFS 1997).

3.2 Adverse Effects on Essential Fish Habitat

NMFS has evaluated the proposed project for potential adverse effects to EFH pursuant to Section 305(b)(2) of the Magnusson-Stevens Fishery Conservation and Management Act. As described and analyzed in the accompanying opinion, NMFS anticipates some short-term sediment impacts will occur downstream of the project locations and outward from banks of estuarine areas. Increased fine sediment could further degrade already degraded habitat conditions in many of the proposed project locations. Flowing water may be temporarily diverted around some projects (salmon EFH), resulting in short-term loss of habitat space and short-term reductions in macroinvertebrates (food for EFH species).

The duration and magnitude of direct effects to EFH associated with implementation of individual restoration projects will be significantly minimized due to the multiple minimization measures utilized during project execution. Short-term adverse effects that occur will be offset by long-term beneficial effects to the function and value of EFH.

3.3 Essential Fish Habitat Conservation Recommendations

Section 305(b)(4)(A) of the Magnusson-Stevens Fishery Conservation and Management Act authorizes NMFS to provide EFH Conservation Recommendations that will minimize adverse effects of an activity on EFH. Although short-term potential adverse effects anticipated as a result of project activities, the proposed minimization and avoidance measures, and terms and conditions in the accompanying opinion are sufficient to avoid, minimize and/or mitigate for the anticipated affects. Therefore, no EFH additional Conservation Recommendations are necessary at this time to avoid, minimize, mitigate, or otherwise offset the adverse effects to EFH.

3.4 Supplemental Consultation

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

4. FISH AND WILDLIFE COORDINATION ACT

The purpose of the Fish and Wildlife Coordination Act (FWCA) is to ensure that wildlife conservation receives equal consideration, and is coordinated with other aspects of water resources development (16 USC 661). The FWCA establishes a consultation requirement for Federal agencies that undertake any action to modify any stream or other body of water for any purpose, including navigation and drainage (16 USC 662(a)), regarding the impacts of their actions on fish and wildlife, and measures to mitigate those impacts. Consistent with this consultation requirement, NMFS provides recommendations and comments to Federal action agencies for the purpose of conserving fish and wildlife resources, and providing equal consideration for these resources. NMFS' recommendations are provided to conserve wildlife resources by preventing loss of and damage to such resources. The FWCA allows the opportunity to provide recommendations for the conservation of all species and habitats within NMFS' authority, not just those currently managed under the ESA and MSA.

The following recommendations apply to the proposed action:

- At any project site within the Action Area that experiences foot traffic, the project applicant should post interpretive signs describing the presence of listed fish and/or critical habitat as well as highlighting their ecological and cultural value.

The action agency must give these recommendations equal consideration with the other aspects of the proposed action so as to meet the purpose of the FWCA.

This concludes the FWCA portion of this consultation.

5. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

5.1 Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the NOAA Restoration Center, U.S. Fish and Wildlife Service, and the U.S. Army Corps of Engineers. Individual copies of this opinion were provided to the NOAA RC, USFWS, and the Corps. This opinion will be posted on the Public Consultation Tracking System website. The format and naming adheres to conventional standards for style.

5.2 Integrity

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

5.3 Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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