UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region, California Central Valley Office
650 Capitol Mall, Suite 5-100
SACRAMENTO, CA 95814

**Refer to NMFS ECO #: WCRO-2024-01347**

March 13, 2025

Mr. Kevin Harper
Chief, Environmental Resources Branch
US Army Corps of Engineers, Sacramento District
1325 J Street
Sacramento, California 95814

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the American River Common Features General Reevaluation Report reinitiation 2024

Dear Mr. Harper:

Thank you for your letter of May 14, 2024, requesting reinitiation 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 American River Common Features General Reevaluation Report reinitiation 2024.

Thank you also for your request for essential fish habitat (EFH) consultation. NMFS reviewed the proposed action for potential effects on EFH pursuant to section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), implementing regulations at 50 CFR 600.920, and agency guidance for use of the ESA consultation process to complete EFH consultation. We have concluded that the action would adversely affect EFH designated under the Pacific Coast Salmon Fishery Management Plan. The EFH consultation concludes with conservation recommendations.

The enclosed biological opinion (opinion) analyzes the effects of the American River Watershed Common Features General Reevaluation Report (ARCF). This opinion is based on the final ARCF biological assessment for the project (USACE 2020), supplemental ARCF reinitiation biological assessment (USACE 2024a) and appendixes, Sacramento Weir operations and maintenance biological assessment (USACE 2024b), and on the best available scientific and commercial information. The opinion concludes that the analyzed project is not likely to jeopardize the continued existence of the federally listed as endangered, Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) evolutionarily significant unit (ESU), the threatened Central Valley spring-run Chinook salmon ESU (*O. tshawytscha*), the threatened southern distinct population segment (sDPS) of the North American green sturgeon (*Acipenser medirostris*), and the threatened California Central Valley steelhead (O. mykiss) DPS, and is not likely to destroy or adversely modify their designated critical habitats. NMFS has included an incidental take statement with reasonable and prudent measures and terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed species associated with the project.

Please contact Lyla Pirkola at the California Central Valley Office of NMFS at (916) 930-5615 or via email at Lyla.Pirkola@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

A. Catherine Marcinkevage

Cathy Marcinkevage
Assistant Regional Administrator for
California Central Valley Office

Enclosure

cc: ARN 151422-WCR2024-SA00023
Robert Chase, Robert.D.Chase@usace.army.mil
Susan Rosebrough, Susan_Rosebrough@nps.gov

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

American River Watershed Common Features General Reevaluation Report

NMFS Consultation ECO Number: WCRO-2024-0134

Action Agency: United States Army Corps of Engineers (USACE)

Affected Species and NMFS' Determinations:

| ESA-Listed Species | Status | Is Action Likely to Adversely Affect Species? | If likely to adversely affect, Is Action Likely to Jeopardize the Species? | Is Action Likely to Adversely Affect Critical Habitat? | If likely to adversely affect, is Action Likely to Destroy or Adversely Modify Critical Habitat? |
|---|---|---|---|---|---|
| Sacramento River winter-run Chinook salmon ESU (*O. tshawytscha*) | Endangered | Yes | No | Yes | No |
| Central Valley spring-run Chinook Salmon ESU (*Oncorhynchus tshawytscha*) | Threatened | Yes | No | Yes | No |
| California Central Valley steelhead DPS (*O. mykiss*) | Threatened | Yes | No | Yes | No |
| Southern DPS of North American green sturgeon (Acipenser medirostris) | Threatened | Yes | No | Yes | No |

| Fishery Management Plan That Identifies EFH in the Project Area | Does Action Have an Adverse Effect on EFH? | Are EFH Conservation Recommendations Provided? |
|---|---|---|
| Pacific Coast Salmon | Yes | Yes |

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

**Issued By**: A. Catherine Marcinkevage
Cathy Marcinkevage
Assistant Regional Administrator for California Central Valley Office

**Date**: March 13, 2025

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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

The National Marine Fisheries Service (NMFS) prepared the biological opinion (opinion) and incidental take statement (ITS) portions of this document in accordance with section 7(b) of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 et seq.), as amended, and implementing regulations at 50 CFR part 402.

We also completed an essential fish habitat (EFH) consultation on the proposed action, in accordance with section 305(b)(2) of the Magnuson–Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et seq.) and implementing regulations at 50 CFR part 600.

We completed pre-dissemination review of this document using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (DQA) (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. A complete record of this consultation is on file at the Sacramento NMFS Office.

## 1.2. Consultation History

Authorization for the overall American River Common Features (ARCF) Project is provided by Section 101 of the Water Resources Development Act (WRDA) of 1996 (PL 104-303), and modified by WRDA 1999, Section 366 (PL 106-53). The authorization was reassessed under a reevaluation study known as the ARCF General Reevaluation Report (GRR) (USACE 2015). On September 9th, 2015, the National Marine Fisheries Service (NMFS) issued an opinion (NMFS 2015) and on September 11, 2015, the U.S. Fish and Wildlife Service (USFWS) issued a biological opinion (File No. 08ESMF00-2014-F-0518; referred herein as 2015 USFWS opinion; USFWS 2015) on the ARCF GRR in accordance with Section 7(a)(2) of the Endangered Species Act of 1973, as amended (ESA) (16 U.S.C. 1531 et seq.). In 2020, reinitiation of consultation with NMFS was requested due to project changes. On May 12, 2021, NMFS issued a reinitiated opinion (referred herein as 2021 NMFS opinion).

The history of the section 7 consultation on the ARCF Project started during the development of the ARCF GRR in 2015. The opinions were issued by NMFS and USFWS as described above. Full consultation history of all aspects prior to this reinitiation can be found in the consultation history of the September 9, 2015, NMFS opinion (referenced in this document as 2015 NMFS opinion) and the 2021 NMFS opinion.

Several aspects of the 2015 and 2021 NMFS opinions have already been implemented or are beginning to be constructed as follows:

- Sacramento River East Levee cutoff walls in several areas (2020-2024)
- Tree removal at several locations (2018-ongoing)
- Partial areas of seepage berm installed on the Sacramento River (2019)
- Beach Stone Lakes Mitigation Site south of Freeport, north of Morrison Creek on the east side of the Sacramento River (2020-2023)
- Arcade Creek (2017-2020)
- Purchase of 20 mitigation credits at Fremont Landing Conservation Bank (2019)
- Lower American River Erosion Contracts 1, 2, and 3A (2022-2024)
- Sacramento River Erosion Contracts 1 and 2 (2021-2024)
- Sacramento Weir (2023-ongoing)

NMFS has provided technical assistance during the development of site designs and the reinitiation Biological Assessment (BA). Project technical assistance and design team involvement have been occurring regularly since the beginning of the project.

- On October 4, 2022, USACE and NMFS discussed proposed project changes including a new construction schedule and infeasibility of the previously proposed mitigation strategy.
- On April 20, 2023, USACE sent NMFS BA-supporting materials including the current schedule and the impacts and mitigation tracking spreadsheet.
- During August 2023, NMFS provided USACE technical assistance in drafting the reinitiated BA.
- On May 13, 2024, NMFS received a letter from USACE describing the proposed project changes with a reinitiation analysis that concluded reinitiation was not triggered.
- On June 25, 2024, NMFS provided USACE with a letter requesting additional information and indicating that formal reinitiation of consultation is required due to changes in the proposed action which may result in effects to listed species and critical habitat in a manner or extent not previously considered.
- On July 16, 2024, USACE provided the additional information NMFS requested with the exception of the analysis related to the Sacramento Weir Operations and Maintenance.
- On August 14, 2024, USACE provided NMFS a BA for the Sacramento Weir operations and maintenance, and consultation was initiated.

### 1.2.1. Completed Actions

USACE has completed construction of flood risk features for the following contracts:

- Sacramento River East Levee (SREL) Seepage and Stability Contracts 1-4
- Sacramento River (SR) Erosion Contract 1-2
- Lower American River (LAR) Erosion Contracts 1-2

The completion of these contracts included site preparation (tree removal and bank grading) as well as cleanup, hydroseeding, and on-site revegetation. The timing and impact acreages for each completed contract are included in Table 1. Construction has also begun and is on-going at the Sacramento Weir (2021 NMFS opinion, Section 1.3.4).

USACE has also completed purchase of 20 acres of salmonid/green sturgeon credits from the Fremont Landing Conservation Bank and 12 acres of salmonid restoration credits from the North Delta Fish Conservation Bank. Both are NMFS-approved banks and credit purchases occurred consistent with the 2021 NMFS opinion.

**Table 1 Timing and Impacts of Completed Contracts**

| Contract | Year(s) completed | Permanent Impacts (acre) | Temporary Impacts (acre) |
|---|---|---|---|
| LAR Contract 1 | 2022-2023 | 8.50 | 0.0 |
| LAR Contract 2 | 2022-2024 | 5.44 | 0.0 |
| SR Contract 1 | 2022 | 3.08 | 0.0 |
| SR Contract 2 | 2023-2024 | 18.03 | 0.0 |
| SREL Contract 1 | 2019-2023 | 0.0 | 0.0 |
| SREL Contract 2 | 2019-2023 | 0.0 | 0.0 |
| SREL Contract 3 | 2019-2023 | 0.0 | 0.003 |
| SREL Contract 4 | 2019-2023 | 0.0 | 1.4 |
| Total | - | 35.05 | 1.403 |

Updates to the regulations governing interagency consultation (50 CFR part 402) were effective on May 6, 2024 (89 Fed. Reg. 24268). We are applying the updated regulations to this consultation. The 2024 regulatory changes, like those from 2019, were intended to improve and clarify the consultation process, and, with one exception from 2024 (offsetting reasonable and prudent measures), were not intended to result in changes to the Services' existing practice in implementing section 7(a)(2) of the Act. 89 Fed. Reg. at 24268; 84 Fed. Reg. at 45015. We have considered the prior rules and affirm that the substantive analysis and conclusions articulated in this biological opinion and incidental take statement would not have been any different under the 2019 regulations or pre-2019 regulations.

### 1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies (see 50 CFR 402.02). We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not. Under the MSA, "federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a federal agency (see 50 CFR 600.910).

The proposed action was previously described in the 2021 NMFS opinion and includes actions to reduce flood risk in the City of Sacramento and surrounding areas by addressing levee seepage, under seepage, erosion, stability, and overtopping concerns along the Sacramento River and American River. Because the nature of the work proposed remains largely unchanged, we have adopted the information provided in the 2021 NMFS opinion by reference where relevant. References to the 2021 NMFS opinion will include the section where the relevant information can be found. A web link to the 2021 NMFS opinion can be found in the References section of this document.

For the purpose of defining the proposed federal action specific to this present request for reinitiating the biological opinion, the sections below describe the actions yet to occur and which are subject to the analysis of this opinion.

### 1.3.1. Updated Proposed Action

According to the 2024 USACE BA, the Updated Proposed Action will accomplish the same goal of reducing flood risk in the City of Sacramento and surrounding areas.

#### 1.3.1.1 Work Windows and Project Schedule

USACE proposes a work window of May 1 - November 30, for work occurring below the Ordinary High Water Mark (OHWM), but outside of the wetted channel. In-water work in the wetted channel will be limited to July 1 – October 31. USACE will contact NMFS in writing via email at least one month prior to the start of construction for any work below the OHWM. NMFS will also be notified by September 30 of each year with a description of any work below the OHWM anticipated past October 31.

Previously, all work associated with the ARCF project was anticipated to be complete by 2024. The current schedule anticipates construction through 2028 as detailed below.

Lower American River (LAR) Erosion:
- LAR Contract 3A, 2025
- LAR Contract 3B, 2026-2027
- LAR Contract 4A, 2028
- LAR Contract 4B, 2028

Sacramento River (SR) Erosion:
- SR Contract 3, 2026-2027

#### 1.3.1.2 American River

USACE has concluded that levees along the American River require improvements to address erosion. The proposed measures for these levees consist of waterside armoring to prevent erosion to the riverbank and levee, which could potentially undermine the levee foundation. Construction is proposed for contracts 3A, 3B, 4A, and 4B on the lower American River. Section 1.3.1 of the 2021 NMFS opinion described the designs for these locations, this includes bank protection, launchable rock trench, toe protection and/or cut banks. Sections 1.3.9 to 1.3.11 of the 2021 NMFS opinion described the construction process, staging, equipment, vegetation planting installations, demobilization, rehabilitation and cleanup.

The design for contract 4A has been updated to include a berm (described below). The remaining three contract designs remain unchanged. The two primary measurements that are used to describe the American River levees in the ARCF GRR: (1) a maximum of 31,000 linear feet (LF) of bank protection, and (2) a maximum of 65 acres/45,000 LF of launchable rock trench. Remaining contract work is currently estimated to result in 30 acres of permanent rock placement along the American River.

**LAR Contract 4A**

Lower American River Contract 4A levee work would be conducted on the "river-right" (facing downstream) bank of the Lower American River near RM 2.0 upstream of the State Route (SR) 160 bridge. To reduce the risk that high-velocity flood waters could scour the levee around the SR160 bridge piers and destabilize the levee, a berm is proposed upstream of the bridge to deflect high-velocity flood waters away from the levee slope. The berm would be armored with rock slope protection (RSP) to prevent erosion. The Jedediah Smith Memorial Trail near the State Highway 160 bridge would be rebuilt as a new permanent paved bike trail route along an existing dirt maintenance / access road. A section of the bike trail would be built along an elevated berm, with an elevation increase from 22 ft to 28 ft, North American Vertical Datum of 1988 (NAVD88) this increase in elevation would create a barrier to fish movement during periods of high water. The berm would enclose approximately five acres of floodplain to form a small basin that would not drain to either the river or wetland along the levee. Based on average flows, this area would be inundated once every nine years.

**American River Mitigation Site (ARMS)**

ARMS is the current proposed mitigation site to offset project impacts on the American River. ARMS is an approximately 120-acre site located between RM 1.0 and RM 1.6 in the American River Parkway, purchased by USACE for mitigation. ARMS is being designed to consider historical and existing conditions to restore, enhance, and maximize habitat for salmonids. The design will restore up to 66 acres of salmonid habitat and will function as a backwater channel that fills through a single inlet from the main river channel located at the southeast limits of the site (Figure 1). Habitat benches will be incorporated into the backwater channels to provide shallow water habitat for juvenile salmonids at various water surface elevations. The benches will be continuous with gradual slopes and a positive gradient toward the main river channel to reduce stranding risks as water recedes. Site design will create backwater floodplain habitats, remove existing non-native vegetation, incorporate instream woody material, and improve connectivity to the main river channel. Excavation would be required to provide connection to the main river channel. The import of material and grading to fill the mining pit in the floodplain is necessary to cover existing debris (e.g., concrete, rip rap) and improve rearing habitat for salmonids by reducing inundation depths and establishing elevations that provide an opportunity for wetland and riparian vegetation to establish and naturally recruit.

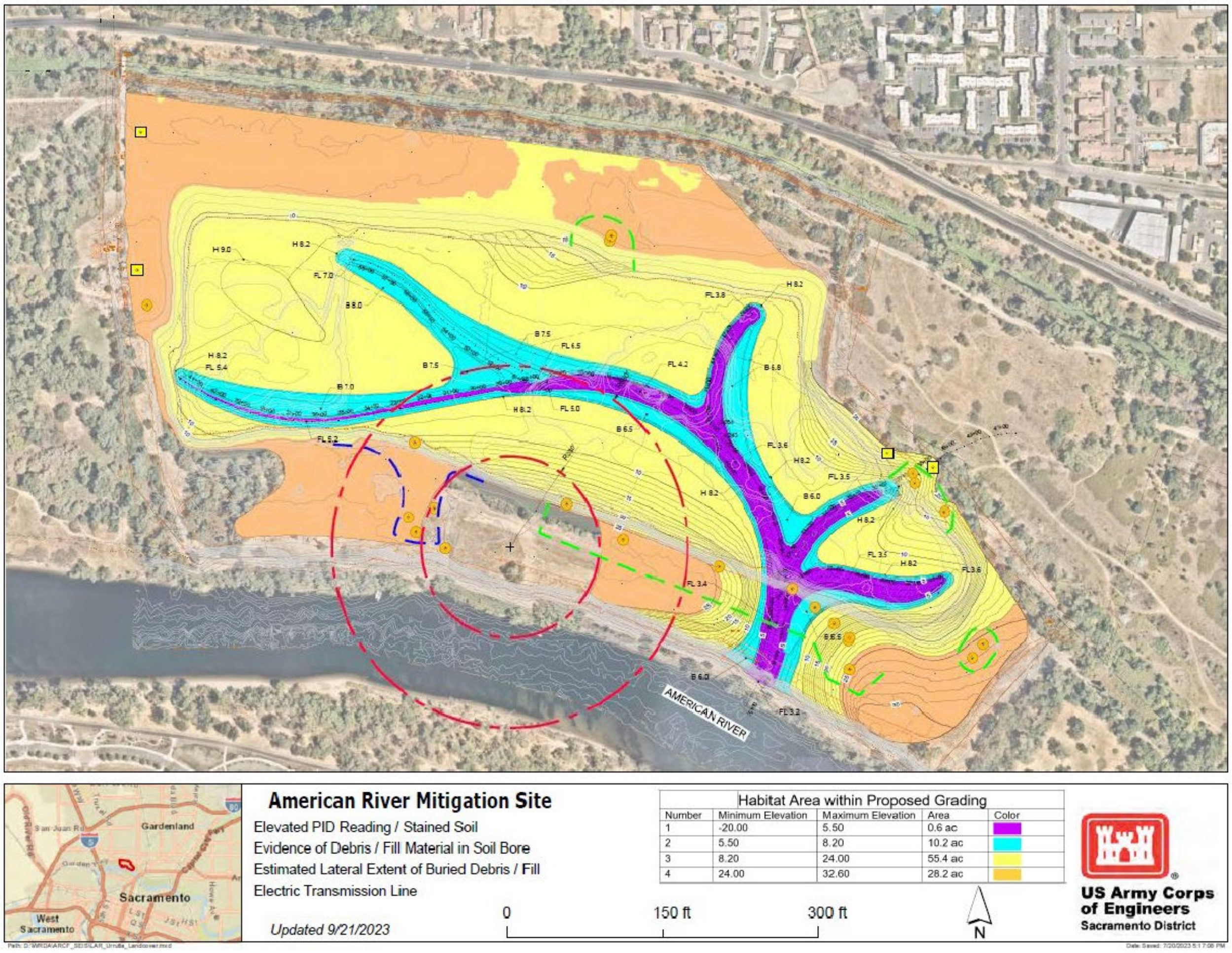



**Figure 1. Proposed American River Mitigation Site Design**

*ARMS Construction Schedule and Sequencing*

Construction is anticipated to begin in 2025 and continue through 2028. Work would typically occur between 7 am and 6 pm Monday through Saturday. Occasional night work may occur. In-water work in the American River main channel, not including areas of the man-made pond behind the river embankment, would occur within the proposed in-water work window for the proposed action. Most channel and riparian features would be completed before the river-right bank is breached to minimize any turbidity impacts on the river. Filling and grading within the existing man-made pond would include partial or complete dewatering to control water during fill operations and may require use of temporary cofferdams or inflatable bladders. A turbidity curtain and/or temporary sheet piles would be installed prior to making the hydrologic connection with the river. Revegetation would occur in the spring, after construction is complete as early as 2026. Demobilization and cleanup would complete the construction phase.

*ARMS Access, Haul Routes and Staging Areas*

Access and haul routes will be on the water side of the levee and below the OHWM. They will only be used while the site is in the dry. Staging areas onsite would be subject to strict containment and spill prevention best management practices (BMPs) to avoid Stormwater Pollution Prevention Plan (SWPPP) violations. Once work is complete, staging areas would be returned to their initial conditions or planted with native vegetation to provide additional habitat.

*ARMS Operations and Maintenance*

The short-term and long-term success criteria, performance criteria, management, operations, and maintenance are under development. A habitat management plan incorporating these standards will be prepared in coordination with project partners and Resource Agencies. Then that plan will be used to update the relevant operations and maintenance manuals. If there is an anticipated effect to listed species related to these activities, a new consultation will be initiated at that time.

#### 1.3.1.3 Sacramento River

USACE reports that levees along the Sacramento River need improvements to address seepage, stability, and erosion to be addressed through cutoff walls, slope stability work, and intermittent height improvements. Construction is proposed for contracts 3 and 4 on the Sacramento River. Section 1.3.3 of the 2021 NMFS opinion describes the designs for these locations. Sections 1.3.9 to 1.3.11 of the 2021 NMFS opinion describe the construction process, staging, equipment, vegetation planting installations, demobilization, rehabilitation and cleanup. Erosion contract 3 is described below, contract 4 remains unchanged from the description in the above referenced sections of the 2021 NMFS opinion. Impacts related to contract 4 are estimated to be approximately 4 acres.

**SR Erosion Contract 3**

Sacramento River Erosion Contract 3 includes three sites totaling 2.8 miles between river miles (RMs) 47.3 and 53.1 in Sacramento's Pocket neighborhood. The planned erosion protection method for each site includes placement of rock revetment on the river-left (facing downstream or east) riverbank to prevent erosion and possible failure of the levee protecting the adjacent Pocket neighborhood. The construction method, materials, equipment, access, staging footprint, and effects to listed species have not changed since the 2021 NMFS opinion. However, the 2021 opinion assumed that Sacramento River Erosion Contract 3 construction would occur in 2023 and 2024, this is no longer the case. The two northern sites are anticipated to be constructed in 2025, and the southern site is anticipated to be constructed in 2026. Tree clearing (completed through a separate service contract) would occur during the fall or winter prior to the relevant site's construction season.

**Sacramento River Mitigation Site (SRMS)**

The Sacramento River Mitigation Site would be constructed on approximately 200-acres at Grand Island, located near Sacramento RM 15 and the confluence of Cache and Steamboat Sloughs. Habitat mitigation improvements would include breaching the existing perimeter berms, grading to create channels, stabilizing bank protection, and vegetation planting (Figure 2).

The site is currently anticipated to generate up to 20 acres of habitat for salmonids and sturgeon. Breaching the berms would allow surface water to flow through constructed channels for tidal wetland habitat. Channels would be designed for tidal circulation to improve food production in the wetland. Revegetation would include a palette of native trees, shrubs, grasses, and aquatic vegetation. Aquatic vegetation would include native submerged and emergent wetland plants. The wetland habitat would provide sheltered slow-moving water, shade, food, and cover for salmonids. The wetland design will incorporate habitat features with the intent to limit the possibility of fish stranding during low water circumstances.

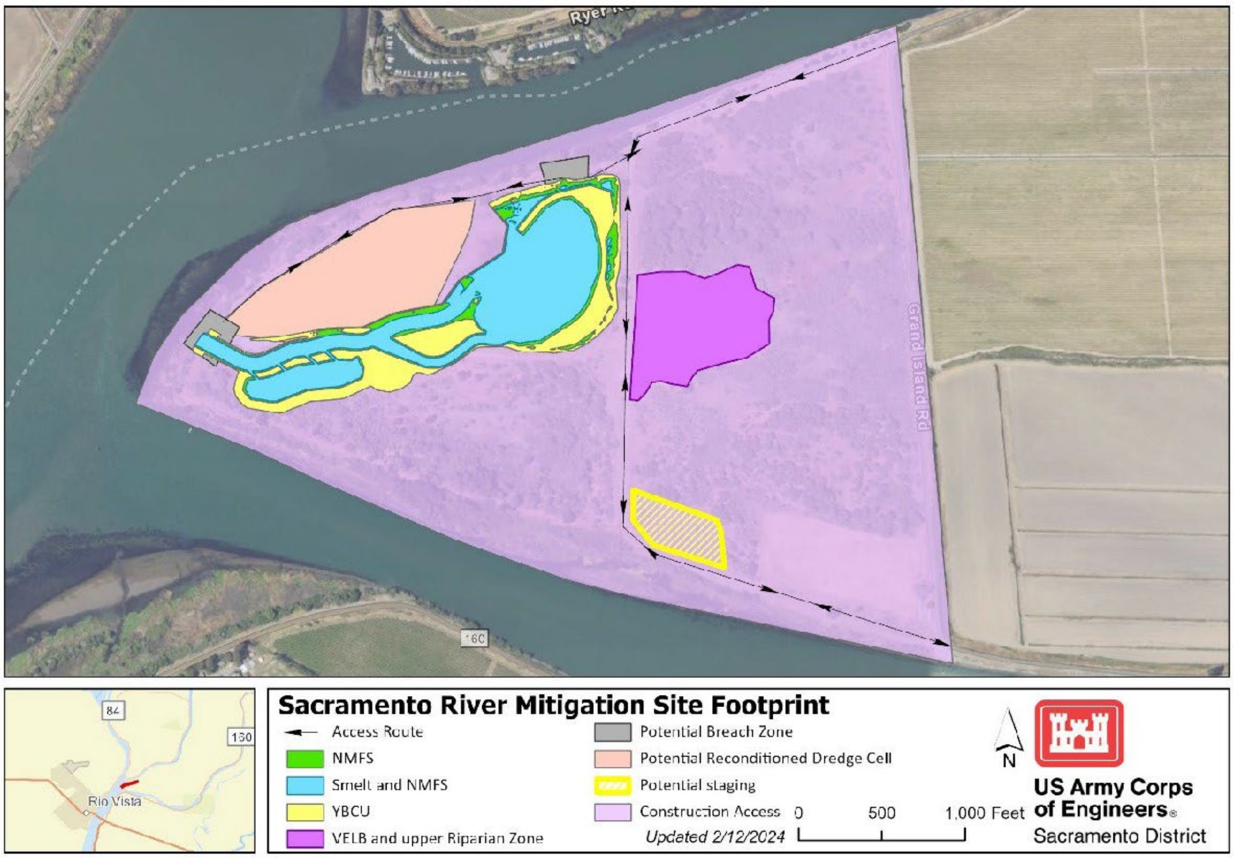



**Figure 2. Sacramento River Mitigation Site Design**

*SRMS Construction Schedule and Sequencing*

SRMS would be constructed over two construction seasons in 2025 and 2026, with revegetation to occur after site contouring is complete. Wetland vegetation would be planted and established for several months prior to breaching the berms to the adjacent water bodies. Work would typically occur between 7am and 6pm Monday through Saturday; however, work times may be extended, including potential occasional night work. A balanced cut-fill design for the wetland (excavation) and riparian habitat (fill for terracing) is an objective to minimize transport of fill, greenhouse gas production, and cost. The construction area is enclosed by a high berm, separating it from water in the adjacent sloughs. Vegetation grubbing and tree removal may occur prior to May. In-water work for aquatic beneficial use features along the outside perimeter of the sites and opening the berms to connect the wetland habitat to the adjacent waterbodies would be permitted within the proposed in-water work window for the proposed action. Demobilization and cleanup would occur in October and November of each year after construction is complete. The staging areas, landside berm slope, and any other bare earth areas would be reseeded with native grasses and forbs to promote revegetation and minimize soil erosion. Any roads or other access areas damaged by construction activities would be fully repaired and restored to preconstruction condition. Trash, excess construction materials, and construction equipment would be removed, and the site would be left in a safe and clean condition.

*SRMS Access, Haul Routes, and Staging Areas*

Site access and haul routes would be via Grand Island Road and maintenance roads within the site. Some work such as tree trimming, minor grading, paving, and adding aggregate may need to be done along the haul routes to allow access to the site. The staging areas would be located within the site boundary. Staging areas would be fenced and would have security lighting. Staging areas would be used for material stockpiles, construction office and trailers, construction worker vehicle parking, and equipment staging. Haul traffic may also pass through staging areas. Waterside staging areas would be subject to strict containment and spill prevention BMPs to help avoid SWPPP violations. Once work is complete, staging areas would be returned to their initial conditions or planted with native vegetation to provide additional habitat.

*SRMS Operations and Maintenance*

The short term and long-term success criteria, performance criteria, management, operations, and maintenance are under development. They will be determined in coordination with project partners and Resource Agencies to draft a habitat management plan that is site specific. Then that plan will be used to update the overarching O&M manuals. If there is an anticipated effect to listed species related to these activities, ESA section 7 consultation will be reinitiated at that time.

#### 1.3.1.4 Additional Ongoing Activities

Additional actions which have been ongoing and anticipated to continue are listed below along with the relevant section in the 2021 NMFS opinion which describe these proposed actions:

- Utility relocation (1.3.5)
- Stormwater pollution prevention (1.3.6)
- Geotechnical explorations (1.3.7)
- Borrow sites and haul routes (1.3.8)
- Operations and Maintenance (1.3.12)

### 1.3.1.5 Mitigation and Compensation

Ongoing actions that will continue to occur related to mitigation and compensation to offset impacts of the project are listed below, along with the relevant section in the 2021 NMFS opinion which describe those actions:

- Green sturgeon habitat mitigation and monitoring plan (1.3.13)
- Green sturgeon study (1.3.14)
- Riparian Habitat Mitigation Site Maintenance (1.3.16)

*Compensatory Mitigation*

In addition to the above-mentioned on-going mitigation and compensation, USACE proposes to incorporate compensation for shaded riparian aquatic (SRA) habitat losses either by project constructed compensation sites (on-site and off-site) or in combination with purchase of credits at a NMFS-approved conservation bank, where appropriate. USACE will construct the ARMS and SRMS restoration locations. The 2021 NMFS opinion established ratios to determine appropriate offset for each acre of impact based on (1) temporal lag in mitigation functionality and (2) proximity of the mitigation site to impacts (2021 NMFS opinion, Section 1.3.17). To address temporal habitat loss, USACE and NMFS agreed upon a ratio factor of one to be added for all permanent impacts if mitigation is not functionally complete concurrent with construction. In considering compensation timing, USACE seeks to avoid exposure of more than one generation of a population with a multiple age class structure (the shortest of which is four years for steelhead). A ratio factor of one will be added for every four years such that functionally-complete mitigation in place prior to construction impacts is credited a 1:1 ratio, within 4 years of construction impacts is a 2:1 ratio, and beyond 4 years is a 3:1 ratio.

These ratios are based on the agreed upon ratios as described in the 2021 NMFS opinion, the locations of the proposed ARMS and SRMS sites, and the current project schedule. USACE will maintain an impact and mitigation ledger and coordinate with NMFS to ensure impacts are offset as proposed. If the timing of impacts and/or mitigation shifts such that a higher ratio would apply, USACE will notify NMFS and provide an updated ledger with ratios based on the most current schedule as well as the proposed form of mitigation to achieve offset (on-site mitigation, off-site mitigation, bank credit purchase, etc.). Impacts are considered to occur at the start of the first construction season. Mitigation is considered complete upon the end of the final construction season for on-site mitigation, or upon 50% complete for offsite mitigation.

Project impacts on the Lower American River will be offset at ARMS at a 2:1 ratio. That is to say, 1 acre of habitat impact on the Lower American River will be considered offset by every 2 acres of restored habitat at ARMS. Impacts on the Sacramento River will be offset at a 1.75:1 ratio with every 1 acre of Sacramento River habitat impact requiring 1.75 acres of restoration at SRMS to offset. Purchase of conservation bank credits may also be used to provide additional offset if needed. Temporal ratios will apply to credit purchases as described above.

### 1.3.1.6 Conservation Measures

USACE proposes the following sets of minimization measures, including mitigation, to minimize and offset effects of the Updated Proposed Action on federally listed fish species. A number of measures are similar to those included in the 2021 opinion and will be undertaken for the entire project, while other measures may be appropriate at specific locations within the project area. Bold text indicates the changes made from the 2021 NMFS opinion.

*Construction Contractor Requirements*

1) In-water construction activities will be conducted within NMFS-approved in-water work windows to avoid and minimize effects to critical salmonid life stages (juvenile rearing, and juvenile/adult migration) typically from July 1 through October 31. **In areas below the OHWM but outside of the wetted channel, work may be conducted with the implementation of additional conservation measures described herein.** USACE will request NMFS approval for any in-water work outside this window.
2) USACE's contractors will develop a SWPPP and Water Pollution Control Plan for each construction contract to prevent and minimize soil or sediment from entering the river, including daily inspections of all heavy equipment for leaks.
3) Contract specifications will minimize the removal of existing vegetation to the greatest practicable extent. When feasible, removed, or disturbed vegetation will be replaced with native riparian vegetation.
4) Contractors will stockpile construction materials and portable equipment, including vehicles and supplies, at designated construction staging areas and barges. **No staging will occur below the OHWM.**
5) Contractors will stockpile all liquid chemicals and supplies at a designated impermeable membrane fuel and refueling station with a 100% containment system **in designated staging areas above the OHWM.**
6) The construction footprint will be limited to the smallest area possible in order to minimize disturbances.
7) To minimize ground and vegetation disturbance during project construction, project limits will be clearly marked, including the boundaries of designated equipment staging areas; ingress and egress corridors; stockpile areas for spoils disposal, soil, and materials; **the OHWM for work limits**, and equipment exclusion zones.
8) Contractors will immediately (within 24 hours) cleanup and report any spills of hazardous materials to the USACE, USFWS, NMFS, and California Department of Fish and Wildlife (CDFW). Any such spills, and the success of clean-up efforts, will also be reported in post- construction compliance reports.
9) USACE will designate a NMFS-approved biologist as the point-of-contact for any contractor who might incidentally take a living, or find a dead, injured, or entrapped fish of a threatened or endangered species. The USACE representative will be identified to Contractor employees during an all-employee education workshop. If lethal take of any ESA listed species occurs, USACE and NMFS will be advised immediately.

*General Commitments*

1) USACE will provide a copy of the issued opinion or similar documentation, to each prime contractor, making the prime contractors responsible for implementing all requirements and obligations included in these documents and for educating and informing all subcontractors about the requirements of the issued opinion and supplemental documentation related to the opinion such as revegetation plans. A notification that contractors have been informed of this information will be provided to the NMFS. A NMFS-approved Worker Environmental Awareness Training Program for construction personnel will be conducted by the NMFS-approved biologist for all construction workers prior to the commencement of construction activities. The program will inform workers of their responsibilities with regard to federally listed fish, their critical habitat, and will provide an overview of the life-history of relevant species, information on take prohibitions, protections afforded these animals under the ESA, and an explanation of the relevant terms and conditions of the operative opinion. Written documentation of the training shall be submitted to NMFS within 30 days of the completion of training.
2) USACE will coordinate construction activities with appropriate hatcheries to suspend in-water work for two (2) days following upstream Chinook releases.
3) Acoustic fish monitoring will be conducted at ARCF sites pre-construction, during and post- construction when feasible. For erosion prevention features along the Sacramento River, USACE plans to conduct telemetry monitoring of green sturgeon for 3 years post-construction. Acoustic telemetry will be conducted in the ARCF action area and will include staff monitoring of real-time telemetry data available online.

*Additional Measures to Reduce Fisheries Impacts*

1) A qualified biologist will be on-site during all construction activities that occur below the OHWM to monitor construction activities and listed fish.
2) Soil disturbance below the OHWM but outside of the wetted channel will be held to the minimum necessary to complete project construction and will be mitigated by application of BMPs, transplanting of elderberry shrubs, or revegetation efforts.
3) Vegetation clearing undertaken below the OHWM and outside of the in-water work window will not include removal of root wads, stumps, or other debris that may significantly disturb the soil to minimize the risk of turbidity and erosion related effects.
4) All trees and shrubs requiring removal will be felled away from the water and debris will be collected without soil disturbance and will be processed outside of the OHWM.
5) Heavy equipment will not be operated within 15 feet from the wetted channel. All vegetation clearing within 15 feet of the wetted channel will be conducted with hand tools.
6) Prior to processing (e.g., bucking, chipping), any cleared vegetation originating below the OHWM will be lifted, not dragged, to above the OHWM to designated staging areas a minimum of 25 feet away from the wetted channel to minimize the influx of vegetation debris into the wetted channel.
7) To avoid any injury or harm to fish caused by extreme sounds, noise or vibration which may be transmitted through water from construction related equipment, the following measures will be implemented when work is conducted below the OHWM and outside of the in-water work window:

a. The Sound Exposure Level (SEL) from the Project will not exceed 187 dB (re: 1 μ$Pa^2$•sec) in any single event, measured at a distance of 32.8 ft from the source. Maintaining this SEL cap ensures that acceptable thresholds for avoidance and minimization of harm are not exceeded.
b. The peak sound pressure level, as a result of Project construction, will not exceed 203 dB (re: 1 μPa peak) in any single strike, measured at a distance of 32.8 ft from the source.
c. 200 feet or greater distance from the wetted channel shall be maintained during placement of riprap below the OHWM outside of the in-water work window.

**1.3.1.7 Sacramento Weir and Fish Passage Facility**

Construction at the Sacramento Weir began in 2023 and will be on-going through 2027. Section 1.3.4 of the 2021 NMFS opinion details the action which includes a new fixed-crest passive weir structure north of the existing Sacramento Weir, setting back the Sacramento Bypass north levee approximately 1,500 feet, a new bridge over the weir on Old River Road, a fish passage structure, a levee embankment between the existing weir and new passive weir, realignment of County Road 124, and removal of the railroad embankment.

Updates to the Sacramento Weir and Fish Passage Facility construction proposed action are limited to changes in the proposed work window. To accommodate completion of construction within three seasons, USACE proposes an April 1 to November 30 work window for work below the OHWM but outside of the wetted channel. This work would include pile driving of 20-inch diameter steel pipe piles, excavation, and heavy equipment usage up to the edge of the active channel (not in-water). In-water work, including the dewatering and cofferdam installation will occur June 1 to November 31. Construction near the wetted channel is expected to mainly occur in late 2025 through 2026.

**1.3.1.8 Sacramento Weir Operations and Maintenance**

The Proposed Action related to Sacramento Weir operations and maintenance (O&M) includes features to increase adult fish passage and reduce fish stranding. The intent of widening the Sacramento Weir is to limit flood stages to the Sacramento River's floodplain, allowing maximum use of the Sacramento River Channel flood capacity downstream of the weir. Adverse effects of the weir may result in fish becoming stranded in the Sacramento Bypass. Enhanced fish passage through the Bypass area will provide a hydraulic pathway to facilitate the safe navigation of adult fish from the Sacramento Bypass to the Sacramento River. Additionally, there is potential for juvenile fish to migrate from the river down through the bypass. This section describes the O&M procedures for the fish passage. Operations and maintenance will be the responsibility of the project's non-federal sponsor, the California Department of Water Resources (DWR).

The new fish passage has four major parts: 1) fish passage structure, 2) exit gate structure allowing fish to return to the Sacramento River, 3) fish passage channel, and 4) bypass transport channel (BTC), plus a drain channel from the existing stilling basin (Figure 3). The fish passage structure consists of a flow control structure and fish ladder. The flow control structure bifurcates incoming flow from the Sacramento River into two concrete channels – the fish ladder and the concrete fish passage channel – and provides a common exit for fish passing upstream out of the Sacramento Bypass en route to the Sacramento River. The flow control structure has two flow control gates: one for the fish ladder and one for the concrete fish passage channel. The fish ladder has 16 pools ranging from 18 to 30 feet in length, separated by single slot baffles with orifices. The fish passage channel portion of the flow control structure has seven single, center-slot baffles.

Downstream of the flow control structure, the concrete fish passage channel transitions into a trapezoidal channel lined with grouted rock slope protection. The stilling basin for the new widened weir drains into the concrete fish passage channel at the downstream end of the flow control structure. The fish passage channel runs parallel to the fish ladder on the north side. The fish ladder and stilling basin flow into the fish passage channel at the entrance pool downstream of the fish ladder. The fish passage channel connects to the bypass transport channel downstream of the combined fish ladder and fish channel. The BTC is a single, earthen, trapezoidal channel that consolidates flows from the fish passage channel and fish ladder to the Tule Canal and interior delta.

A new drain channel connects the stilling basin of the existing weir to the BTC, ultimately draining to Tule Canal. Modifications to the existing stilling basin allow the full length of the existing stilling basin to drain into that new drain channel. The new drain to the existing weir stilling basin is not intended as a fish passage function from bypass to Sacramento River, but only to mitigate stranding in the existing weir stilling basin by providing a reasonable path from the existing stilling basin to the BTC. Once fish enter the BTC, the purpose of the drain channel is complete.

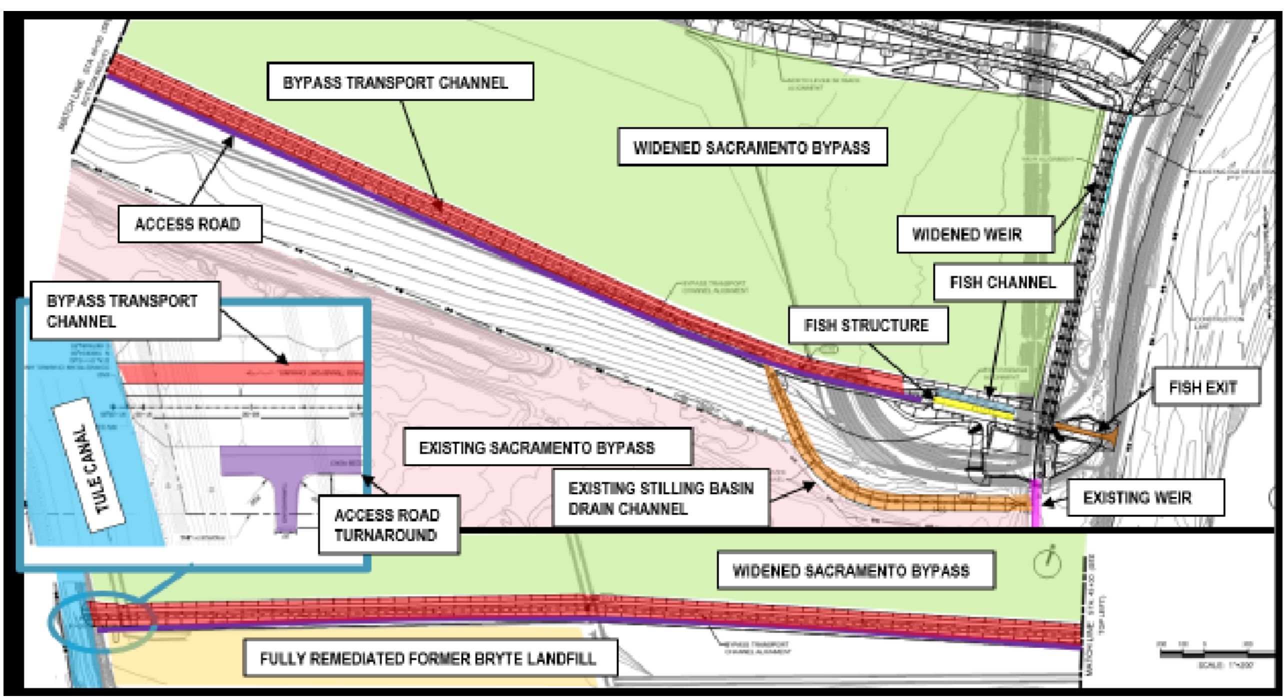


**Figure 3. Sacramento Weir Fish Passage Overview**

The debris management system upstream of the flow control structure where fish exit into the Sacramento River protects the fish passage structure from floating debris. The debris wall and floating debris barrier guide the flow of debris around the exit channel in two directions, either back to the Sacramento River or over the existing weir into the bypass. The retaining wall would primarily be used for access by DWR maintenance crews to reach the fish structure exit for cleaning and maintenance. The overall debris management system helps limit the volume of debris that can accumulate at the fish passage structure exit, helps guide hydraulics to limit fallback of fish when returning to the Sacramento River, and improves access to remove debris when accumulation occurs.

#### 1.3.1.8.1 Normal Startup and Operating Procedure

This section describes the equipment operation for each functional system of this facility. It also provides initial system setpoints based on an operational strategy and summarizes an approach to adaptively manage and improve facility operations over time.

**Facility Operational Strategy**

In a flood event, the Sacramento River's water surface elevation (WSE) rises, and at 26 feet and higher water spills over the weir, in which flow attracts fish from the bypass, through the passage facility and back into the river. The fish passage structure begins to operate when the hydrograph is on the descending limb of the storm event, and the WSE returns to 27 feet. That elevation triggers the fish ladder gate to begin opening, to allow the gate more opportunity to reach full open by the time the river reaches WSE 26. Opening the fish ladder gate allows water to go down the fish ladder (i.e., fish passage begins to operate).

At WSE 17 feet, the fish passage channel gate opens and spills water into the fish passage channel. Both the fish ladder and fish passage channel operate between WSE 17 feet and 14 feet. At WSE 14 feet, the fish ladder gate closes and only the fish passage channel gate remains open until WSE 10 feet. When the WSE reaches 10 feet the fish passage channel gate closes, and operation of the fish facility is completely shut down until the next triggering storm event. There are other scenarios that trigger facility shutdown such as the end of known ESA listed fish migration, downstream impacts, and agriculture summer operations. Gates close on May 31 each year regardless of WSEs. Except for summer closure, other closure scenarios require communication between DWR flood maintenance and operation staff and Central Valley Flood Operations during every event to determine the right operational strategy to close the gates.

In the event the WSE in the Sacramento Bypass is greater than the WSE in the Sacramento River, both gates in the flow control structure would be closed to prevent water from flowing backward (from the Sacramento Bypass into the Sacramento River). Flow would be prevented from flowing backward when the WSE in the Sacramento Bypass is below the weir crest elevation (EL) 26.0. At WSEs in the Sacramento Bypass above EL 26, water would flow freely over the Sacramento Weir, from the Sacramento Bypass, into the Sacramento River.

The WSE downstream of the fish passage structure is controlled by the WSE in the Sacramento Bypass, in the Yolo Bypass, in Tule Canal, or the BTC, depending on the hydraulic conditions downstream of the fish passage structure. The facilities are designed to provide passage between WSEs 26 feet and 10 feet in the Sacramento River when the downstream WSE is controlled by the BTC. The downstream WSE will be higher when the elevation is controlled by the Sacramento Bypass, Yolo Bypass, or Tule Canal. In the event this occurs, fish would be able to volitionally pass between the Sacramento River and Tule Canal more easily because most of the passage structure would be submerged and the velocities relatively reduced. Given that the purpose of the structure is to provide passage and avoid stranding, the flow regime in this situation would not pose a specific issue.

The fish passage flow control gates either operate fully open or fully closed, they do not operate partially open. The gates are controlled by a stream gauge, a wall-mounted pressure transducer, which is at the upstream side of the fish passage structure gates, on the south retaining wall just outside (east of) the fish passage structure. The currently installed gauge north of the existing weir will be replaced with a new gauge (bubbler) to serve as a backup gauge for fish ladder operations in case the main gauge malfunctions. Both gauges are connected to the supervisory control and data acquisition (SCADA) system.

For safety reasons, the initial operation of the gates must be triggered by an operator. Once a WSE 27 feet has been reached on the descending hydrograph, the signal from the pressure transducer gauge triggers the SCADA system to send an alarm for the operators. The alarm is accompanied by a dialog box asking the operators if they wish to initiate fish passage operation. The operators would perform an in person, visual security check that no one is downstream of the fish ladder or fish passage channel, or within the BTC. When operators confirm the channels are free of any significant obstruction to operation or human presence, the operators must push the button on the human interface (HMI) screen to initiate the otherwise automatic operation of the fish passage gates. Once initiated, automated fish passage operation starts with the sounding of the alarm tower siren, followed by the opening of the fish ladder gate. The fish passage channel gate opens automatically when the desired WSE is reached. The security check takes place when the fish passage structure starts up for the first time during a storm event. Shutdown will take place automatically when the set WSEs are reached. For safety reasons, the gates will have full lockout-tagout capability to prevent inundation of workers or equipment downstream due to inadvertent gate operation.

**Facility Seasonal Start-Up**

Prior to annual readiness of the facility (October 1 of each year), all pre-season activities will be completed as follows:

- Adaptive management measures are implemented as determined through the cooperative decision-making process.
- The O&M Manual for this facility is updated and revised in accordance with staff changes, lessons learned, facility modifications, or recommendations arising from an adaptive management process, as deemed necessary by DWR.
- Any training necessary for new staff is accomplished.

- Verify all facility equipment is maintained per this manual and conforms to manufacturer's maintenance recommendations.
- All facility equipment has been inspected and functionality tests conducted to confirm that all are in good working order.
- Install Adaptive Resolution Imaging Sonar (ARIS) cameras and acoustic sensors.

Upon completion of the pre-season readiness activities, the facility and all such equipment should be ready to operate as intended during a normal operational mode. Facility start-up will commence on October 1 of each year or thereafter when winter seasonal floods are expected to occur. October 1 was chosen based on historical hydrographs starting in 1983 through 2019. This date may be adjusted if future rain event trends show an earlier or later start. Start-up procedures begin with verifying the gates are in their normal operation position (closed). Once it is verified the gates are closed, the control panel switch will be moved from the OFF position to the REMOTE position, allowing automatic operation to begin upon initiation by the operator at the HMI screen.

**Normal Operations**

When operating during the flood period (winter months), the facility operational strategy hierarchy on the SCADA is as follows:

1) When the river levels reach a WSE of 26 feet, an alarm will notify the operators that the gates need to be opened soon, which should prompt operators to conduct the security check.
2) Operators will visually verify (in person) that no safety concerns exist prior to opening the gates.
3) When flood waters begin to recede for a period of 30 minutes and WSEs remain below 27 feet, a second alarm will go off that the fish ladder gate needs to be opened. Operators will push a start button on the SCADA to begin automated actuation th ofe fish ladder and fish passage gates. The SCADA system will call the fish ladder gate to open. The receding period will be adjustable by the operator at the HMI screen, to allow for adaptive management of the system.
4) When flood waters recede to WSE 17 feet, a screen notification will appear to inform the operators that the fish passage channel gate is opening. The fish passage channel gate will open automatically.
5) When flood waters recede to WSE 14 feet, the fish ladder gate closes automatically. A notification will appear on the SCADA.
6) When flood waters recede to WSE 10 feet, the fish passage channel gate closes automatically, and the automated fish passage operation ends. A notification will appear on the SCADA, which also indicates the fish passage structure is shutting down.

This operational strategy assumes that Steps 1 through 6 listed above are carried out normally through an algorithm programmed into the local programmable logic controller (PLC) that is interconnected with the various power, communication, and monitoring systems at the facility.

In the case of an ongoing storm event with an oscillating hydrograph, the SCADA system will automatically adjust the fish ladder and fish passage channel gates per the WSE changes. If the WSE is between 27 feet and 17 feet, only the fish ladder gate is open. At WSEs between 17 feet and 14 feet, both gates are open. For WSEs between 14 feet and 10 feet, only the fish passage channel gate is open.

For example, if the WSE is at 13 feet, the fish ladder gate is closed and the fish passage gate is open. A storm event causes the WSE to rise again to 19 feet. The fish ladder gate will open when the WSE reaches 14 feet, and the fish passage gate will close when the WSE reaches 17 feet. If the WSE goes above 27 feet again, the fish ladder gate will close until the hydrograph is on the receding side and falls to WSE 27 feet again, triggering the fish ladder gate to open. In the event the WSE varies between 26 feet and 27 feet during an ongoing storm, the fish ladder gate would remain open. The gates would close if the Sacramento Bypass WSE exceeded the Sacramento River WSE.

##### 1.3.1.8.2 System Equipment and Operating Procedures

This section describes the equipment used to operate the facility, operational modes, and operational procedures.

*Flow Control Structure*

The fish passage structure is comprised of the flow control structure and fish ladder. Flow through the flow control structure is controlled by two gates: the fish ladder and fish passage channel gates. The gates are the same type of lift gates with different sizes. They are equipped with an actuator for automatic operation. Upstream and downstream of each gate are guide slots for temporary bulkheads to allow the gate area to be dewatered for maintenance or emergency repair. Maintenance platforms, a catwalk, and stairway provide access to the gates.

*Gates and Actuators*

Both flow control gates are equipped with one actuator per gate for automated operation. The actuators for each gate are identical and independently operable. The gates are vertical lift gates with wheels for manual operation. The actuators are connected to the local PLC, which is connected to the pressure transducers that signal the PLC to trigger the actuators. The PLC is in the utility building south of the fish passage structure

The actuators feature LOCAL/OFF/REMOTE switches and a pendant with OPEN/STOP/CLOSE buttons. Actuator switches are to be locked away when not in use. The pendants plug in near the actuator and are removable. When not in use, store the pendants inside the locked utility building and lock the junction boxes where the pendants plug. The actuators display gate position as a percentage of open. Any gate put in either LOCAL or OFF position, while the system is operating in AUTO mode, causes the gate to be removed from the sequence of control, and the system continues to attempt automatic control with the remaining equipment. When the gate is in the OFF position, it is inhibited from movement both locally and remotely. Gate closing rates are estimated to be a maximum of 1.1 foot per second. The gates can be operated in the following ways, 1) automatic operation, 2) local operation, 3) manual operation. Each operation method is described below.

*Automatic Operation*
When a gate is in the REMOTE position, the PLC has control and can open and close the gate as required by the logic algorithm. When placed in SCADA AUTO mode, the gates are controlled by the pressure transducers that send the WSE to the PLC.

*Local Operation*
An electric pendant connection is installed at the gate to allow local gate operation. The pendant itself is stored in the utility building for security reasons. When a gate is in the LOCAL position, the pendant has control and can open and close the gate as required by the operator. The intended use for the pendant is for maintenance.

*Manual Operation*
Gates are also equipped with a handwheel to manually open and close the gate. To open or close a gate, press the push button (clutch) located in the middle of handwheel and rotate the handwheel until the gate moves to the desired position. Manual operation can also be achieved with a square nut operator and a portable, powered, mechanical valve operator.

*Bulkheads*

There are two sets of bulkheads: One set of 16-foot-wide bulkheads is provided for four identical bulkhead slots. These bulkheads are provided to isolate the gates and/or each channel (fish ladder and fish passage). There are approximately12 bulkhead panels for both gates (up to 5 panels per slot and 2 spare panels) that are stored adjacent to the utility building when not in use. A second set of 18-foot-wide bulkheads is provided at the fish exit with approximately 5 bulkhead panels (and one spare panel) to isolate the fish passage structure. These panels are stored at the fish exit retaining wall. The bulkheads isolate the channels and/or gates so repair and maintenance for the gates may be conducted in dry conditions. Isolation from the Sacramento Bypass and Sacramento River is provided up to WSE 30.6 feet (about 10-year Sacramento River flood). It is not anticipated that the bulkheads are used during the operational period of the fish structure, as they are designed for static water conditions. The bulkhead panels require manual installation to be lowered into the bulkhead slots. To set the bulkhead panels into the guide slots, a crane needs to be brought to the site. As part of the bulkhead panels, a spreader bar is stored on site. The spreader bar attaches to the crane and picks up the panels and puts them into the slots. Bulkhead panels can only be installed when water is not flowing in the channel. The bulkhead panels can be installed at any WSE in the channel where installation can be performed safely

*Fish Passage Channel*

The fish passage channel provides egress for adult fish migrating north from the Sacramento Bypass into the Sacramento River when the WSE ranges from 10 feet to 17 feet. The channel begins at the downstream end of the flow control structure. Flows from the flow control structure and fish ladder converge into the fish passage channel and head downstream into the BTC. This will also allow any juveniles migrating south to pass safely. The most upstream portion of the fish passage channel is hardened with grouted rock. At the fish ladder entrance pool, the channel lining is compactable soil, sands, and gravels. The fish passage channel requires maintenance, but no operations activities except for the safety checks.

*Bypass Transport Channel (BTC)*

The BTC is an open channel that receives and conveys water for about 8,500 feet (1.6 miles) from the confluence of the fish ladder and fish passage channel to the Tule Canal. Most of the BTC is native material with some sections of grouted riprap. The BTC requires maintenance, but no operations activities.

*Existing Weir Drain Channel*

The existing weir drain channel (EWDC) is an open channel that connects the stilling basin at the north end of the existing weir with the BTC. Gravity drains the stilling basin of the existing weir into the BTC to provide an escape for fish when waters recede. The first 30 feet of the EWDC, following the transition structure, is a grouted riprap reach with a bottom width of 10 feet. Protection of the EWDC side slopes is provided using appropriately sized riprap. The channel invert downstream of the grouted riprap reach consists of coarsened streambed material, including a designed gradation of material from boulders to fines, which is expected to remain stable during high flow events. The EWDC is approximately 1,375 feet long. The downstream end, prior to the confluence with the BTC, is crossed by the proposed access road via a low flow crossing (Arizona Crossing) that includes a downstream cutoff wall and rock apron to prevent degradation. The drain channel to the existing weir requires maintenance, but no operations activities.

*Debris Management System*

The debris management system prevents floating debris from entering the fish passage structure and is between the Sacramento River and fish passage exit. The debris management system includes several components intended to: 1) protect the flow control gates from incurring damage from impact of large floating debris; 2) help guide floating debris passing down the Sacramento River around the fish passage structure; and 3) reduce the amount of debris that enters the fish passage structure. Features in this system include the debris wall, debris fence, and floating debris barrier. The debris management system requires maintenance, but no operations.

The floating debris barrier operates automatically via buoyancy, moving as the Sacramento River WSE rises and falls. The floating debris barrier is between the east end of the debris wall and the northeast corner of the retaining wall, along the south side of the fish passage exit channel. Periodic visual inspection of the floating debris barrier is needed to confirm it remains in place; large debris may hit the floating barrier disabling its ability to float and providing opportunity for debris to enter the fish passage structure. Debris that accumulates at the floating debris barrier must be removed to protect the facility. The debris can only be removed when it is safe to do so, either during a non-operational period or when the WSE is low enough that equipment access is available.

*Power Supply System*

Power for the fish passage control structure is provided by grid power. A utility building that houses the electrical gear is located south of the fish passage structure. Power is provided to the gate actuators, via remote motor starters controlled by the local control panel in the electrical building and provides for local operations with a handheld pendant. Power and control wiring are distributed to the fish passage structure via underground conduits to the gate structures, then surface mounted conduit to the various electrical loads on site.

In case of a power outage, a portable generator would be brought to the site by DWR staff and connected to the utility building. Once the generator is connected, staff would need to manually adjust the transfer switch to the generator source, and manually switch back to the utility source once the utility power is available again. Because the site always requires power to properly operate in accordance with design, standby power needs to be provided to the site. In the event of an unplanned loss of grid power, the gates would remain in their positions at the time of power loss. If power is lost outside of the operational period, then operators may operate the gates manually using the handwheel or valve-boss until temporary or permanent power is restored. However, the gates will be closed outside the operational period unless their position is changed by the operators for maintenance purposes. If power is lost while the fish passage facility is operating each gate would stop in a full open, full closed, or partially open position. In such an event, operators would determine how the gate positions may impact the safety of people and infrastructure; and how the position of the gates may impact fish passage performance. If gate positions must be changed for safety, operators would do so manually via the handwheel or a valve-boss.

*Instrumentation, Control, and Communication System*

The “instrumentation and control system” provides remote observation and control capability. The local PLC acts as the data control platform and communicates via ethernet with all interconnected equipment. Data is transmitted via Ethernet/IP protocol over fiber optic connection and an internet service provider. Information is provided to the PLC via feedback from all integrated equipment and instruments. Instrumentation includes the pressure transducers to measure WSEs. The data monitored on the PLC is the WSE, gate positions, motor status, gate remote status, emergency stop, control power available, and system alarms. The local control in the utility building can override the remote control. In the event data communication via the internet is lost, automated operation of the fish passage facility via the on-site SCADA system will continue.

The WSE for the fish passage structure will be measured at three locations with level transducers. One is at the far end of the fish ladder (fish ladder entrance), the second is at the downstream end of the concrete fish passage channel, and the third is attached to the retaining wall upstream of the fish exit. The stream gauge serves as backup to the fish exit level transducer.

*Alarm Systems and Security*

Several alarms are provided to let the operators know that something needs attention. Audible and visual hardwired alarms will activate for public notification prior to operation. Headwater and tailwater alarms will indicate when the fish passage structure gates should open and close. Additional alarms will be in place to indicate infrastructure malfunction, loss of power, intrusion, and to indicate when the system is placed in MANUAL or OFF.

*Site Access*

An access road is necessary to provide ingress/egress for operation and maintenance vehicles and personnel. The access road connects an area for maintenance benches established adjacent to the southern wall of the fish passage structure (east access bench), and at the west end of the fish passage structure (west access bench). The access road is 20 feet wide with 12 inches of compacted gravel over 8 inches of lime modified subgrade. An 18-foot-wide access road over native soil also parallels the BTC from the Tule Canal to the access roads and maintenance benches located near the fish passage structure. The access road and maintenance benches need to be maintained, but do not require special operation activities.

#### 1.3.1.8.3 Scheduled Maintenance Procedure

This section describes scheduled (i.e., preventive) maintenance procedures at the Sacramento Weir fish passage facility. Equipment provided by a manufacturer requires additional inspections per the manufacturer's recommendations. These inspections are not included in this manual and can be obtained from the specific manufacturer operation and maintenance manuals.

**Inspection and Maintenance Schedule**

The facility inspection and maintenance schedule are in progress documents. Details of required inspection and maintenance activities will continue to be developed as information is received from the construction contractor. DWR would be responsible for all O&M activities. Because of funding and resource limitations, DWR may not be able to complete all maintenance activities annually or on a set rotational basis. DWR's maintenance activities are limited by operational capacity; therefore, maintenance activities are conducted on an as-needed basis. In some cases, maintenance activities may be conducted at an interval of several years to decades, while in other areas maintenance activities are conducted annually or every-couple-of-years, when more frequent maintenance activity is required. Monthly timing described herein is when maintenance activities generally occur. However, these activities may occur outside of these timeframes if work is necessary for continued safe operations or conditions allow. Categories of O&M activities include sediment removal, debris/obstruction removal, upland vegetation management, channel vegetation management, pipe/culvert maintenance, and channel scour repair.

*Sediment Removal*

Sediment removal will occur at variable frequencies dependent on rate and magnitude of accumulation as well as effects on conveyance and function. Sediment removal at structures such as culverts is anticipated to occur between April-November, while removal from structures including the BTC channel, fish passage structure, and fish passage channel will occur May through October with the option to extend into January based on canal conditions.

*Debris/Obstruction Removal*

Removal of debris (including trash, flood-deposited woody and herbaceous vegetation, downed trees/branches, and any other human debris) from structures may occur year-round as needed based on inspection. It is anticipated that debris will be removed annually with approximately 10% of channels being cleared every five years.

*Upland Vegetation Management*

Physical/mechanical treatments for upland vegetation management include mowing, grazing, strip disking, and controlled burning. Mowing would occur annually within the expanded Sacramento Bypass. For the grassland habitat surrounding the wetted BTC, grazing and strip disking would be limited in use or applied in localized situations. These activities may occur from March to December. Herbicide and pesticide application may occur year-round and is expected to be conducted on approximately 20% (1.2 acres) of the grasslands adjacent to the wetted portion of the BTC annually. Woody vegetation removal will consist of trimming, limbing, cutting, and masticating which will occur between May to August with equipment and year-round with hand tools. Woody vegetation removal will typically occur every several years on an as-needed basis with approximately 1 acre of the expanded Sacramento Bypass area expected to be removed annually. Finally, any bulldozing associated with woody vegetation removal will occur as needed between May to November as conditions allow.

*Channel Vegetation Management*

Channel vegetation management includes the ~6-acre wetted BTC and ~12-acre dry BTC. Aquatic vegetation removal methods include mechanical removal with an excavator or dragline and herbicide/pesticide application. Aquatic vegetation removal will occur on an annual basis, as needed, between May and October. Up to 20% of the BTC area may be cleared annually. Woody vegetation removal will be achieved using trimming, limbing, cutting with hand tools, masticating, and bulldozing. This work will typically occur every several years on an as-needed basis, expected approximately once every 7-12 years. Woody vegetation removal will be limited to May to November with the potential to extend as conditions allow. Work with hand tools may occur year-round. Approximately 10% (0.18 acre) of woody vegetation in the BTC would be removed annually. Herbicide and pesticide application may also be used to remove woody vegetation. Application will be at an as-needed basis to target undesirable plants and will be conducted on approximately 10% of the BTC annually.

*Pipe and Culvert Repair and Replacement*

Pipe and culvert inspections will occur year-round annually. Repair, replacement, and abandonment would be limited to April to November. Minor repairs may occur year-round. The amount of annual disturbance will vary and would likely be limited in scope and to localized areas estimated at 0.5 acre once every 50 years, or 0.01 acre annually.

*Channel Scour Repair*

Channel scour repair would only occur near the Sacramento Weir in the Sacramento Bypass and at the BTC outlet at the Tule Canal, between the months of April and November. Repair of dry portions of the BTC and bypass will occur by scraping, disking, filling, leveling, and regrading the ground surface as needed. This work will be conducted approximately every ten years in approximately 10% of the extended bypass and 10% of the BTC (0.06 acres).

**Inspection and Maintenance Procedures**

Equipment-specific maintenance procedures are summarized below. Preventative maintenance is outlined for the following equipment:

- Fish passage structure, fish passage channel, BTC
- Slide gates
- Bulkheads
- Fish salvage (Section 1.2.3.7.4)

*Fish Passage Structure, Fish Passage Channel, BTC, EWDC*

*Bypass Transport Channel (BTC)*
Most of the BTC is native material. Vegetation growth is a primary concern in this area. Removal of vegetation and debris from the structure will be critical for unimpeded fish passage. Sedimentation, erosion, and scour can occur in the BTC. Occasional re-grading of the BTC may be required to address sedimentation, erosion, and scour. Refer to the maintenance outlined under the Access Road section below for proper re-grading techniques. Some parts of the BTC are grouted riprap. The BTC can be maintained and re-graded with native backfill material using equipment positioned on the access road.

*Fish Passage Structure*
The fish passage structure consists of reinforced concrete with a series of pools, weirs, slots, and ramps that allow fish to swim upstream to reach the Sacramento River. After each flood event, and when the channel is dry, the structures need to be cleaned and debris removed using appropriate equipment. It also may be necessary to remove debris by hand, especially right behind the weirs to prevent damage to the weir walls.

*Fish Passage Channel*
The fish passage channel is made with grouted riprap. Vegetation removal is the most important maintenance item for unimpeded fish passage. If enough sedimentation occurs that affects the volume or surface elevation of the channel and/or the BTC, it will have to be managed to ensure that the channel maintains appropriate gradient and stranding pools are not present.

*Existing Weir Drain Channel (EWDC)*

Along the EWDC, an 8-foot-wide by 7-foot-tall, finished opening is planned to facilitate a request by DWR to drive equipment the full length of the existing stilling basin. The skid steer would be able to remove debris and sedimentation from the EWDC.

*Slide Gates*
Other than periodic cleaning to maintain smooth operation or painting to maintain appearance, no maintenance is required on slide gates. Gates may require occasional cycling to alleviate sticking

*Bulkheads*
The bulkheads should be inspected annually; overgrown vegetation removed; and bulkheads cleaned of dirt or other obstructive materials. The guide slots for the bulkheads need to be inspected annually to make sure they are free of any obstructions. Slide slots will be cleaned to ensure proper fitting of the bulkheads.

Regular maintenance and cleaning of the fish passage structure is anticipated to primarily occur in the summer and early fall and may require use of the bulkheads. Cleaning of the concrete channels and maintenance of the gates requiring the use of the bulkheads would be focused on periods of low flow in the Sacramento River, when the water depth in the fish passage structure is low enough to allow personnel to work in the wet channel. This equates to about 3 feet of water depth, or Sacramento River WSE 11 feet or less. The flushing method for removing sediment from bulkhead slots would largely be used prior to May 31. In rare instances, flushing may be required after May 31, but would be considered either an emergency situation or uncommon cleaning event. Flushing would raise gates up to 2 feet and allow for flushing to occur for about 30 minutes, but not exceed two hours. The total volume of water expected to be passed during this time would generally be 745,000 gallons or 2.3 acre-feet but may range up to 8.4 million gallons or 26 acre-feet. The overall usage of water would be minimal and the potential for attractant flow for downstream fishes would be negligible. Any water diverted at the upstream end would be protected by a screen of appropriate size and mesh, as identified by NMFS screening guidelines.

The cleaning method is part of the adaptive management required for maintenance of the facility. This approach is expected to be reviewed and modified throughout the life of the facility based on the performance of this cleaning method.

#### 1.3.1.8.4 Fish Salvage

In the event fish salvaging needs to occur after facility operation, it is anticipated that the California Department of Fish and Wildlife (CDFW) will conduct fish salvaging and rescue operations. The salvaging would be conducted through existing and future contracts established between CDFW and DWR, through the U.S. Bureau of Reclamation. CDFW currently and historically has conducted most fish salvaging operations within the Central Valley at weir facilities, including the existing Sacramento Weir.

It is anticipated CDFW will lead a qualified team to perform Fish Handling and Relocation (FH&R) field work. CDFW will safely remove and transport aquatic species from the

Sacramento Bypasses, stilling basins, fish passage structure, fish passage channel, and bypass transport channel to locations upstream or downstream in the Sacramento River or Tule Canal, outside of harm's way. The following are anticipated of CDFW's FH&R Team and DWR Operations and Maintenance:

1) All permitting will be addressed under CDFW's existing authority and within the standard operating procedures as established by CDFW for fish salvage that have been maintained and updated, as needed.
2) DWR will coordinate with CDFW prior to when FH&R is anticipated to be needed. FH&R dates will be established and agreed upon by both entities. This coordination must include lockout tagout to prevent gate operation when workers are downstream.
3) During FH&R efforts, personnel will provide fish transport, net installation, spotting, and other efforts as required to safely relocate aquatic species. CDFW will provide the following personnel dedicated to the FH&R effort:
    a. Able-bodied labor personnel, capable of traversing over varied terrain while carrying buckets or other vessels containing water and aquatic life and weighing up to 50 pounds.
    b. Equipment operators and equipment spotters.
    c. Personnel trained in fish collection, handling, transport, identification, and relocation. Personnel with training deemed inadequate shall not perform FH&R work.
4) CDFW will provide the necessary materials and equipment necessary to perform the FH&R effort. Materials and equipment may include:
    a. Weighted and floated seine nets.
    b. Equipment dedicated to the task of fish transport, 4-wheeled motorized cart with large bucket and aerators, or similar. The purpose of this equipment is to shuttle aquatic life to designated release locations in adjacent river areas.

Fish salvage will be an adaptive management activity. The approach identified herein is expected to be reviewed and modified throughout the life of the facility based on its performance and environmental, regulatory, and other requirements.

#### 1.3.1.8.5 Implement Cooperative Decision-Making Process

This section describes the cooperative process that will be used to make joint decisions and/or recommendations on any modifications to operations and maintenance of the proposed action. Participants, committee structure, and a description of how the process will operate are outlined in the subsequent sections. Success is dependent upon each participants commitment to the implementation of the process outlined herein. All participants recognize that each agency has statutory responsibilities that cannot be delegated, and the cooperative decision-making process does not and is not intended to invalidate the statutory responsibility of any committee participant.

**Cooperative Process Participants**

The following agencies will participate in the Cooperative Decision-making Process: the USACE, DWR, and NMFS. The U.S. Fish and Wildlife Service (USFWS) and CDFW also have an interest in the proposed action and this cooperative process; therefore, their expertise will be sought where appropriate. These agencies will participate in one of two committees that will drive the cooperative decision-making process: the management committee and the biology committee.

*Management Committee*

The management committee governs the process. Oversight and administration of the cooperative decision-making process will be the primary responsibility of the management committee. This committee will also be responsible for guiding activities of technical-level staff participating in the biological committee. USACE will chair the management committee with cooperation from DWR. As chair, USACE will receive information and recommendations from the biological committee and make final decisions and/or recommendations regarding proposed annual operations and maintenance activities. The management committee will also lead discussions on inter-basin coordination with other managers of the Yolo Bypass facilities to address facility performance and any adjustments as needed to optimize conditions. Technical experts may be invited to such meetings, but the initiation and coordination of the meetings will be the responsibility of the management committee.

*Biology Committee*

The biology committee serves in an advisory role to the management committee, with a primary responsibility to provide technical recommendations to the management committee on all NMFS-regulated species issues. Members include USACE, DWR, and NMFS. SAFCA may participate as a non-federal sponsor as needed. Each member will have one voice in the cooperative decision-making process. Participation will not be restricted to one person from each member agency; rather, professional expertise from different backgrounds (e.g., hydrology, engineering, fish biology, and water quality) will be sought. Expertise from outside consultants, agencies, or entities such as USFWS and CDFW will be sought where appropriate. USACE will serve as Chair of the biology committees. This committee will meet annually, each summer, to review monitoring data from the preceding season if data were collected, and the weir operated. During non-operation years when monitoring didn’t occur in the prior season, discussion on anticipated operations, maintenance or other related activities will occur. Additional meetings will be scheduled as needed to evaluate new information required to provide recommendations to the management committee. Monitoring at the fish passage structure while it is in operation will occur up to, but not exceed, five years post-construction.

**Annual Reporting**

A single annual report will be generated to provide the foundations for the cooperative decision-making process that will include a summary of biological data (if collected), overall progress, and any activity outside of monitoring pertinent to maintaining the performance of the facility as related to fish passage. Annual reports and meetings will only occur when the weir and facility have operated that calendar year. This document will be developed by the management committee prior to implementation. Monitoring and evaluation activities, other necessary operations and maintenance activities (that may impact fish passage performance, positively or negatively) to be accomplished by the next flood season, along with the proposed schedule will be provided. The report is not a comprehensive report of maintenance and operations but focused on aspects related to fish passage. USACE will submit the draft annual monitoring report to the biology committee for review on or before October 1 of each year after the latest overtopping has occurred. The biology committee members will have one month to review the report and submit recommended comments.

#### 1.3.1.8.6 Post Construction Evaluations

The post-construction evaluation period is intended to verify that the as-built fish passage structure reasonably conforms to the design specifications outlined in Section 1.3.4. of the 2021 NMFS opinion. These evaluations are not intended to result in retrofits to the proposed action unless the as-built installation does not conform to the design specifications within a reasonable margin of performance. Three post-construction evaluations will be performed to determine if the fish passage structure is performing as intended: (1) verification that the fish passage structure is installed in accordance with the approved design and that construction procedures are sound; (2) validate hydraulic conditions in the fish passage structure to confirm it is performing as expected; and (3) perform biological monitoring to confirm successful fish passage.

**Fish Passage Structure As-Built Conformance**

The contractor will be required to ensure incorporation of digital advanced models during construction activities and will perform all modeling in AutoDesk Civil 3D or other modeling software as approved by the Contracting Officer. The contractor will prepare the Working As-built, Final As-built and Shop drawing files for approval. Upon completion of work, the contractor will provide Final As-built Record Drawings, which are the final, complete, fully approved record of actual conditions and elements reflected in the as-built drawings. The Final As-built Record Drawings will be provided to NMFS when available.

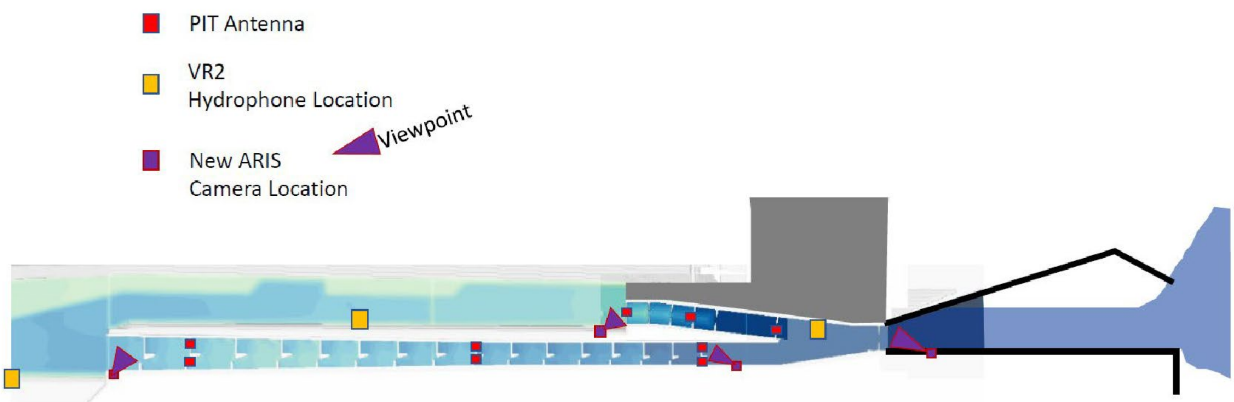
**Water Velocity and Depth Validation**

Water velocities and depths would be monitored inside the fish passage structure over the two full over-topping events (water stage exceeds 26') and not a 5-year period following post-construction monitoring period as required by the 2020 NMFS opinion (Fisheries Conservation Measure #20). This revision was developed in coordination and under the preference of the NMFS representative biologist and Sacramento weir PDT. The purpose post-construction evaluation is to determine if conditions throughout the fish passage structure are suitable for upstream migration of adult salmonids and sturgeon. It is anticipated that flow velocities and depths would be monitored throughout the structure at a variety of flow levels during operation. All collected data will be processed into a technical memo to characterize findings following the following season.

**Fish Passage Monitoring**

USACE will implement a fish passage monitoring program to understand the presence, movement, and behavior of fishes moving through and around the fish passage structure and project site. Monitoring will use three technologies, each with its own benefit: acoustic hydrophones, PIT antennas, and ARIS cameras. Data collected using these monitoring techniques will be used to determine if the fish passage structure is meeting the performance metrics defined below. Figure 4 depicts the approximately location of each monitoring component, these locations may be adjusted slightly as required during construction and installation.

**Figure 4. Fish Passage Monitoring Components Approximate Locations**




**Fish Passage Structure Performance Metrics**

Specific performance metrics for the fish passage structure may be updated or adaptively modified based on findings of the post-construction evaluations and cooperative decision-making process. The following performance metrics were collaboratively identified with NMFS to establish a baseline for discussion and to highlight the nature, detail, and scope of performance metrics anticipated.

1) Timely passage is important for all species using the facility and will be species specific. Salmonids are anticipated to move efficiently through the system within the course of a day, but sturgeon may take more time or even temporarily hold. Stacking is defined as fish collecting in a specific area and holding for long periods of time (days to weeks). Stacking is not desired and will be monitored for and addressed as needed if it is shown adverse harm was caused to the species.
2) Consistent operation of equipment during monitoring is also key. Semifrequent checks of the Passive Integrated Transponder (PIT) and acoustic telemetry system with dummy tags will be employed to test. Also, imagery checks of the ARIS cameras and adjustment to the image focus/location with motorized mounts will be conducted and documented.
3) Pooling or standing water that may result in stranding is not desired. Upon gates closing and water receding, checks for any pooled water or areas not allowing fish to exit will be

sought out visually. CDFW will report on any stranding issues during their salvage activities as well to the USACE.

4) Poaching is outside the control of the proposed action proponents, but any observed poaching activity will be reported on and addressed by CDFW. The proposed action is generally setup to avoid poaching (signage and limited access) and any unauthorized activity will be considered trespassing and against the law, but if poaching frequency is notable, discussion on actions that may be taken by CDFW or other responsible enforcement entities will occur.

The following post-construction evaluations will be performed to document that the as-built installation of the fish passage structure is meeting the anticipated performance metrics.

*Hydrophones*

Hydrophones will be deployed to detect acoustic transmitters previously surgically implanted within adult green sturgeon. Currently, Vemco/Innovasea brand transmitters and receivers are deployed in the Sacramento River. A pool of tagged adult green sturgeon currently exists, and further efforts are planned to increase the number of tagged adults associated with other proposed actions. The benefit of the hydroacoustic array is that adults can be detected for long distances (sometimes upwards of 500m or more), transmitters can last for up to 10 years, and detection stations are autonomous and relatively easy to deploy. Up to four locations consisting of approximately 10 receivers are planned to be deployed in the area of the Sacramento Weir fish passage facility, one near the intersection of the Tule Canal and the BTC, one near the Sacramento River entrance to the fish passage facility, and one near the entry of both the fish ladder and fish passage channel. Each location will have a VR2W and HR3 (or equivalent) frequency hydrophones to detect different tag frequency types. The hydrophones will be capable of detecting the presence of individually identified green sturgeon by logging a code ID and a timestamp. Data is downloaded from the hydrophones when accessible and saved to a hard drive for processing. Hydrophones can rapidly be deployed and removed, so it is expected that the units will be installed seasonally if it appears that the fish passage channel will operate.

*PIT Antennas*

The fish passage facility will be fitted with custom PIT antennas utilizing full duplex scanning technology. PIT transmitters or tags do not require a battery and are very small (9-12 millimeters in length). The tags are energized when they pass into a field created by the detection antennas where they can then transmit their unique identifier code that is associated with a time stamp. The lack of an onboard battery means that the transmitter can last for the life of the fish. Also, due to their small size and relatively inexpensive cost, tags were placed in green sturgeon when they were tagged with the larger (more costly) acoustic tags, mentioned above. In addition, it is common for salmonids to be tagged with PIT transmitters as well, providing benefit for other potential studies on fish movement. Detection antennas are planned to be installed in three locations of the fish passage channel and in three locations of the fish ladder. Since the fish ladder has both orifices and slots for fish passage (i.e., two routes), a total of two antennas for each of the three locations will be deployed (six total). By separating out the orifice and vertical slot pathway detection zones, the exact pathway the fish took can be identified.

All detections will be shared with NMFS and other stakeholders, so that other researchers can be provided with detection information if their tags are identified passing through the facility. Detection antennas will be permanently installed, and all receiver and logging hardware will be housed alongside other electrical equipment in a dedicated closed area. Units will be turned on and activated if the facility begins operation, which can be done from the electrical equipment room.

*Acoustic Cameras*

Acoustic cameras will be deployed to monitor fish behavior in detail. The ARIS is the most common and readily available device for monitoring during storm conditions. The camera produces an image similar to a high-definition sonogram and records live movement in video format. Cameras use sound to create an image, so the camera can 'see' through turbid water and in the absence of light. Only underwater aeration or excessive movement (i.e., unstable or shaky mount platform) will cause the image to degrade.

The camera will be capable of detecting fish size and movement, but species identification will be challenging. Unless the fish is of moderate size and unique morphology, will it have a chance to be identified to species. Sub-adult and adult sturgeon may meet those requirements but differentiating green from white sturgeon will be difficult.

Cameras are anticipated to be deployed below each fish passage channel, at the top of the fish ladder, and at the entry to the fish passage facility on the Sacramento River side. Continuous footage will be collected and then manually reviewed by a technician where species characterization and behavior can be documented. Camera positioning may be altered with a mechanized rotator if conditions permit (cable length, power source, etc.). Cameras will be housed in cabinets and thus are fixed positions unless substantial modification occurs after the fact. It can be anticipated that cameras will be installed and positioned at the beginning of monitoring and then will not be moved until they are removed. Greater flexibility may occur but will be determined based on engineering and equipment requirements.

*Data Collection and Reporting*

Monitoring data will be downloaded at an interval that matches logistical feasibility. Hydrophones may be difficult to access during operation and thus only downloaded once after an operational season. PIT antennas and ARIS cameras are anticipated to have electronics readily accessible and, therefore, data can be downloaded weekly or accessed daily, if a situation calls for it. However, safety of staff is paramount and data downloads/collection may not occur until conditions are warranted safe.

*Facility Post-Construction Review*

Biological performance monitoring will occur over two over-topping events. Monitoring from these events will primarily be used to determine if the fish passage structure is serving its intended purpose and function, safe passage of NMFS-regulated species during operation. To determine if the fish passage structure is performing as intended, performance metrics have been established and the aforementioned post-construction evaluations will be performed. After two overtopping events have occurred, the management committee will review the evaluation data and recommend adjustments to long-term operations and maintenance activities received from the biology committee. If all data from both events confirm that the fish passage structure is performing as intended, post-construction evaluations will be suspended.

The purpose of the fish passage facility is to provide passage for any fish that is present, but is not intended to attract fish or provide a primary pathway for migration. In addition, other managed floodways within the Sacramento River watershed may attract fish by way of flow and velocity pathways, away from the Sacramento Weir Fish Passage facility. As a result, there is the potential for fish to not pass at the facility and lead to no detections of a fish passage event. In the event that no detections occur, but previously described testing shows that equipment is operating appropriately, there will not be any expectation or requirement for a minimum number of fish detection events.

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

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

## 2.1. Analytical Approach

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

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

The designations of critical habitat for listed species use the term primary constituent element (PCE) or essential features. The 2016 final rule (81 FR 7414; February 11, 2016) that revised the critical habitat regulations (50 CFR 424.12) replaced this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a "destruction or adverse modification" analysis, which is the same regardless of whether the original designation identified PCEs, PBFs, or essential features. In this biological opinion, we use the term PBF to mean PCE or essential feature, as appropriate for the specific critical habitat.

The ESA Section 7 implementing regulations define effects of the action using the term "consequences" (50 CFR 402.02). As explained in the preamble to the final rule revising the definition and adding this term (84 FR 44976, 44977; August 27, 2019), that revision does not change the scope of our analysis, and in this opinion we use the terms "effects" and "consequences" interchangeably.

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

- Evaluate the rangewide status of the species and critical habitat expected to be adversely affected by the proposed action.
- Evaluate the environmental baseline of the species and critical habitat.
- Evaluate the effects of the proposed action on species and their critical habitat using an exposure–response approach.
- Evaluate cumulative effects.
- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species; or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.
- If necessary, suggest a reasonable and prudent alternative to the proposed action.

### 2.1.1. Compensation Timing

As described in the proposed action, this project proposed compensation of unavoidable effects to species and impacts to their habitat. NMFS adopts the approach to compensation timing used for the analysis in the 2021 NMFS opinion. Under this approach, the timing for completed compensation should be to target avoiding exposure of more than one generation of a population with a multiple age class structure. Negative impacts extending beyond those years (Green sturgeon: 15 years: Chinook salmon, 5 years: Central Valley steelhead, 4 years) may have additional detrimental effects to the species. Beyond those timeframes, impacts would reduce the species survival and recovery in the wild, or substantially reduce the value of habitat for the conservation of the species, because the adverse effects (reduced growth and survival of individuals) would begin to reduce the number of reproducing individuals across multiple generations. As such, this opinion applies the following maximum timing for completed compensation as general targets for meeting the intended value of offsetting long-term effects of the proposed action:

- Chinook salmon, 5 years

- Central Valley steelhead, 4 years
- Green sturgeon: 15 years

The combination of on-site and off-site mitigation and associated timing included in the proposed action has a substantial portion of mitigation occurring either prior to or concurrent with construction, or immediately following, so as not to surpass the earliest of those targets (steelhead, 4 years).

We expect, with the combination of on-site mitigation, large offsite mitigation, research funding, and with the variety of minimization and conservation measures being implemented, the impacts to species and habitat will be offset over the course of the entire remaining construction timeline, as opposed to having all adverse effects occurring simultaneously, and lag in mitigation execution.

### 2.1.2. Description of Assumptions Used in this Analysis

For the purpose of the analysis of the habitat being affected by the proposed action, some reasonable assumptions were made for aspects with some uncertainty. One assumption made was due to the uncertainty of final designs for the sites. In coordination with USFWS (whose biological opinion also included riparian mitigation), and after discussions with the USACE, impacts to NMFS species are calculated from the OHWM and below for the purposes of calculating mitigation amounts. While NMFS analyzes all the likely effects of the project (whether above or below the OHWM), it is expected that by calculating the area of impact from the full rock placement (including rock placed at depths that would not generally be utilized by salmonids), that the calculation will be appropriate to provide an estimate of mitigation acreage for USACE's proposed compensation. If at any time this assumption proves to be inaccurate in determining the extent of effects, reinitiation will be required.

Another decision between multiple potential analytical methods for this opinion's analysis is in regards to the calculation of area of impact. For all impacts on banks/levees, NMFS considers the full measure of the actual acreage of impacts measured across the full slope where these effects are occurring. Another method proposed the use of the "lateral extent" of the repairs, which involves calculation of the area of a straight line from the top of the repair, horizontally out into the center of the channel, to the end of the repair. When comparing these methods, the "lateral extent" method ranged in accuracy with results overestimating impact by two to ten times the acres actually being impacted. This method has thus been deemed inaccurate and unacceptable as a form of effects analysis, and will not be used by NMFS as a method of analysis. NMFS will use the actual area of impact to determine habitat effects.

## 2.2. Rangewide Status of the Species and Critical Habitat

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

### 2.2.1. Sacramento River Winter-run Chinook Salmon

**Introduction and Background**

The Sacramento River (SR) winter-run Chinook salmon ESU includes winter-run Chinook salmon spawning naturally in the Sacramento River and its tributaries, as well as winter-run Chinook salmon that are part of the conservation hatchery program at the Livingston Stone National Fish Hatchery (LSNFH; 70 FR 37204).

*Listing Classification and 5-year Reviews*

In 1989, under an emergency interim rule, NMFS listed SR winter-run Chinook salmon under the ESA and classified it as a threatened species (54 FR 32085). This initial classification, as threatened, was reaffirmed in 1990 (55 FR 46515). The species was subsequently up-listed to endangered in 1994 (59 FR 440), and reaffirmed in 2005 (70 FR 37159). In the previous 5-year review, it was recommended that the SR winter-run Chinook salmon should remain listed as endangered (NMFS 2016; 81 FR 33468). Likewise, in the most recent 5-year review for SR winter-run Chinook salmon, NMFS again concluded that the species should remain listed as endangered (NMFS 2024).

*Reasons for Decline of the Species*

Factors leading to the listing included: (1) the continued decline and increased variability of run sizes since its first listing as a threatened species in 1989; (2) the expectation of weak returns in future years as the result of two small year classes (1991 and 1993); and (3) continued threats to the SR winter-run Chinook salmon. Despite the recent number of habitat improvements, there remain major concerns related to SR winter-run Chinook salmon habitat. Primary among these concerns is the continued lack of access to historical spawning habitats above Shasta and Keswick dams that relegate the species to a single spawning population below Keswick Dam (NMFS 2014). Starting in 2017, efforts were initiated to establish a second population of SR winter-run Chinook salmon in Battle Creek to add to the spatial diversity and abundance of the SR winter-run Chinook salmon ESU (USFWS 2020). Efforts are underway to restore the Battle Creek watershed and reintroduce [winter-run Chinook] salmon to the historical habitats therein (ICF International 2016). Disease and predation are persistent problems that continue to adversely affect SR winter-run Chinook salmon. However, updated information from the USFWS and the LSNFH indicates that the threat of disease may only pose a significant risk to SR winter-run Chinook salmon in drought years where conditions such as low flows and high temperatures in the Sacramento River predominate (Lehman et al. 2022). In addition to the threats of disease and predation, other related factors have emerged, such as invasive vegetation (Conrad et al. 2020) and chronic thiamine deficiency (Mantua et al. 2021), which are understood to negatively affect SR winter-run Chinook salmon survival.

## Life History

SR winter-run Chinook salmon are unique to California's Central Valley because they spawn during summer months when air temperatures achieve their yearly maximum. As a result, SR winter-run Chinook salmon require access to reaches with cold water sources that will protect embryos and juveniles from the warm ambient conditions in summer.

Adult SR winter-run Chinook salmon migrate upstream through the Delta and into the lower Sacramento River from December through July, with a peak in January through April (USFWS 1995). SR winter-run Chinook salmon hold for several months prior to spawning, to reach sexual maturity. Spawning occurs in the mainstem Sacramento River between Keswick Dam (River Mile [RM] 302) and the Red Bluff Diversion Dam (RBDD; RM 243), from late-April to mid-August, with a peak in June and July (Killam 2023). Embryo incubation in the Sacramento River can extend into October (Vogel and Marine 1991).

SR winter-run Chinook salmon fry rearing in the upper Sacramento River exhibit peak abundance during September, with fry and juvenile emigration past RBDD occurring from July through November (Poytress *et al*. 2014), then continuing downstream through May in some years (Snider and Titus 2000).

## Viable Salmonid Population Assessment

The four parameters of the "Viable Salmon Populations" (VSP) described by McElhany *et al.* (2000), are summarized below. For the full current analysis, refer to the most recent Viability Assessment (Johnson *et al.* 2023).

*Spatial structure and diversity*

The lack of population redundancy in the SR winter-run Chinook salmon ESU is the primary factor contributing to its high extinction risk. The "jumpstart" to the Battle Creek reintroduction efforts initiated in 2017 mark a significant milestone towards the goal of establishing a second SR winter-run Chinook salmon population (ICF International 2016; USFWS 2020), which is a priority recovery action identified in the recovery plan (NMFS 2014a). The most recent returns of 942, 167 and 127 (2020-2022) adult SR winter-run Chinook salmon to Battle Creek are another indication that reintroduction efforts are beginning to take hold (Azat 2023).

Spatial structure also promotes life-history diversity which has been shown to improve the resilience of salmon populations (Schindler *et al*. 2010, Johnson *et al*. 2017). Diverse habitats provide variation in localized temperature and food resources that influences growth and phenotypic diversity (size and timing of outmigration) in salmon populations. Recent work by Phillis *et al*. (2018) suggests that SR winter-run Chinook salmon may rely on more diverse rearing habitats than previously considered (NMFS 1993). In particular this work identifies the influence of non-natal Sacramento River tributaries and the Delta on juvenile rearing and survival (Phillis *et al*. 2018).

During the 2012-2016 drought, LSNFH increased the number of adults used in the supplementation program from a target of 120 adults to 164, 388, 257, 137 in 2013–2016, respectively (Azat 2023). This expanded production resulted in a significant increase in the proportion of hatchery-reared fish that returned to spawn (>80%) in 2017 and 2018 (Killam 2023). By comparison the numbers of natural-origin spawners in 2017 and 2018 were low (153 and 461 individuals), resulting in a significant increase in the relative contribution of LSNFH hatchery-origin fish to the genetic diversity of the population. Hatchery collection of adults was again increased to 191, 298 and 482 to address drought impacts in 2020-2022.
Projects to reintroduce into Battle Creek are on-going while reintroduction to historical habitats upstream of Shasta Reservoir are in the planning and early implementation phases. In the summer of 2020, juvenile salmon were observed in Battle Creek indicating the first successful spawning of winter-run Chinook salmon in Battle Creek in over 100 years. Further, assessments of habitat conditions in the McCloud River and achievable Chinook salmon smolt survival (70%) through the reservoir to Shasta Forebay show promise (Hansen et al. 2017; Hansen et al. 2018). If successful, the establishment of multiple self-sustaining populations of SRWRC would significantly benefit SRWRC.

*Abundance and productivity*

The abundance of the SR winter-run Chinook salmon ESU has declined during recent periods of unfavorable ocean conditions (2005–2006) and prolonged drought (2007–2009, 2012–2016, 2020-2022) (Johnson *et al*. 2023). The egg to fry survival estimate for brood year 2014 is 5%, which is a significant departure from the average of 26.4% for brood years 2002–2012 measured at RBDD (Poytress *et al*. 2014; Johnson *et al*. 2017). Warm temperatures in both freshwater and ocean ecosystems likely contributed to the low numbers of natural-origin adults observed in 2017 and 2018 (Killam 2023).

Based on the estimates and counts provided in the CDFW "GrandTab" escapement data (Azat 2023), SR winter-run Chinook salmon abundance has declined since 2006 with recent decadal lows of 795 of in-river spawners in 2017. Escapement improved in 2018 - 2021 such that both the current total population size (sum of last three years (2020– 2022); N: LSNFH = 971, Sacramento River = 21,640) and 3-year mean run sizes (Ne: LSNFH = 324, Sacramento River = 7,213) satisfy the low-risk abundance criterion (N > 2500) (Johnson *et al*. 2023).

As stated in Johnson et. al (2023), the point estimate for the 10-year trend in 3-year mean run size is 3.28, suggesting a 3-fold increase in the 3-year average run size over the last 10 years, bolstered by the relatively large escapement in 2019 - 2021 (average run size = 8,603). Although the recent maximum year-to-year decline in population size is 58.8% (2018) does not exceed the catastrophic decline criteria (>90% decline in one generation nor annual run size < 500 spawners)(Lindley et al. 2007), the 2012-2016 drought had a biologically significant effect on annual run sizes for natural-origin spawners in 2017 and 2018 (153 and 461 individuals) which would otherwise place the population at a moderate risk of extinction.

**Recovery**

On July 22, 2014 (79 FR 42504), NMFS completed the 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 2014a). The recovery criteria includes establishing 3 historical populations to viable status. In the most recent 5-year review for SR winter-run Chinook salmon (NMFS 2024), NMFS identified the most significant impacts to the species' persistence due to natural or man-made factors are those related to drought impacts and hatchery influence. Although complex, and interrelated to many other stressors, the factors of drought and hatchery influence pose an increasing threat to the SR winter-run Chinook salmon ESU.

*Drought*

Overall, rising atmospheric temperatures have exacerbated an already high evaporative demand in the region such that the region frequently experiences a significant moisture deficit. The moisture deficit results in low-flow and warm water temperatures in the Sacramento River that in turn limits successful spawning, egg incubation, fry development and emergence.

*Hatchery Impacts*

Hatchery programs can affect naturally produced populations of salmon and steelhead in a variety of ways, including competition (for spawning sites and food) and predation effects, disease effects, genetic effects (*i.e.*, outbreeding depression, hatchery-influenced selection), broodstock collection effects (*i.e.*, to population diversity), and facility effects (*i.e.*, water withdrawals, effluent discharge) (NMFS 2018). And while expansion of hatchery production of SR winter-run Chinook salmon at LSNFH was necessary to address the poor in-river conditions experienced during recent droughts, these actions have continued to affect the ESU (*i.e.*, increased hatchery influence).

*Climate Change*

Crozier *et al*. (2019) assessed climate change vulnerability for Pacific salmon species where it was found that several factors contribute to the overall ranking of the SR winter-run Chinook salmon ESU as "very highly vulnerable" to climate change. The poor population viability of this single population spawning outside of its historical range was the greatest risk, as the ESU is not thriving under current climate conditions which are expected to worsen.

**Sacramento River Winter-run Chinook Salmon critical habitat**

Designated critical habitat includes the Sacramento River from Keswick Dam RM 302 to Chipps Island (RM 0) at the westward margin of the Sacramento-San Joaquin Delta (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. The designation includes the river water, river bottom and adjacent riparian zones used by fry and juveniles for rearing.

As a result of human-made barriers to migration, especially the construction of major dams, SR winter-run Chinook salmon have been confined to lower elevation river mainstems that historically only were used for migration. The greatly reduced spawning and rearing habitat has resulted in declines in population abundance. Additionally, the remaining habitat is of lower quality, in particular because of higher water temperatures in late summer and fall, reduced gravel recruitment, and lack of instream large woody material (LWM).

The critical habitat designation for SR winter-run Chinook salmon lists the essential physical and biological features ((58 FR 33212); June 16, 1993), which include:

1) Access from the Pacific Ocean to spawning areas;
2) 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 at 5.8–14.1°C (42.5–57.5°F) for successful spawning, egg incubation, and fry development; riparian and floodplain habitat that provides for successful juvenile development and survival;
5) Access to downstream areas so that juveniles can migrate from spawning grounds to the San Francisco Bay and the Pacific Ocean.

The current condition of SR winter-run Chinook salmon critical habitat PBFs have been degraded from their historical condition within the action area. Although there are exceptions, the majority of streams and rivers in the ESU have impaired habitat. Additionally, critical habitat in the ESU often lacks the ability to establish essential features due to ongoing human activities. Water utilization in many regions throughout the ESU reduces summer base flows, which limits the establishment of several essential features, such as water quality and water quantity.

In the Sacramento River and adjacent tributaries, bank armoring has significantly reduced the quantity of floodplain rearing habitat for juvenile salmonids and has altered the natural geomorphology of the river (NMFS 2014). SR winter-run Chinook salmon are only able to access large floodplain areas, such as the Yolo Bypass, under certain hydrologic conditions which do not occur in drier years. 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).

Although the current conditions of SR 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.

**Summary**

Overall, the SR winter-run Chinook salmon ESU is at a high risk of extinction and will remain as such until additional populations are established. The overall viability of the ESU has been in decline since the 2015 viability assessment (Johnson and Lindley 2016). The spatial structure of the ESU remains limited to the single population found in the mainstem Sacramento River, and the genetic and life history diversity of the ESU may have been negatively affected by the increased hatchery production implemented to address drought conditions. The ESU also continues to face threats from disease; predation; habitat loss, alteration, and degradation; and is particularly susceptible to climate change and drought (NMFS 2024).

### 2.2.2. Central Valley Spring-run Chinook Salmon

#### Introduction and Background

In 1999 (64 FR 50394), NMFS listed Central Valley (CV) spring-run Chinook salmon under the Endangered Species Act (ESA) and classified it as a threatened species. This initial classification was reaffirmed in 2005 when the Feather River Fish Hatchery (FRFH) population was added to the ESU (70 FR 37159). Critical habitat for CV spring-run Chinook salmon was later designated in 2005 (70 FR 52488).

#### Life History

Generally, adult CV spring-run Chinook salmon fish migrate from the Pacific Ocean in a reproductively immature state and swim upstream into fresh water in the spring months (approximately March through June) using olfactory senses to locate their birth waters. The adult fish then hold over summer months (approximately June through September), and spawn in cold freshwater in the early fall months (approximately September through November). Larval fish, also known as 'alevins,' hatch from eggs and emerge from their gravel nests throughout the fall and early winter months (approximately October through December). Juvenile fish then rear and feed in freshwater from late fall through spring (approximately October through June); or may choose to rear for a full year (*i.e.*, October to subsequent October to December), and become 'yearling' juveniles when conditions are suitable.

As juvenile fish rear, they migrate downstream and eventually reach the Sacramento-San Joaquin River Delta, and then the San Francisco Bay estuary. Once juvenile fish have completed the physiological changes necessary to enter saltwater (called smoltification), they enter the Pacific Ocean and rear until adulthood for approximately three to four years, which is typical for Chinook salmon. Once adult fish are three or four years old, they migrate back upstream to freshwater to start the life cycle over again and create the next generation. All Chinook salmon are "semelparous" fish, meaning they reproduce once in their lifetime and then die shortly after spawning.

In general, wetter water years result in higher survival of juveniles out-migrating during the spring of the same year they emerged. In three to four years, the juvenile cohort that experienced wetter outmigration conditions, are more likely to result in a higher abundance of adults returning to freshwater to spawn. Drier water years generally result in low survival during spring outmigration and encourages a subset (roughly 10%) of juveniles to express the yearling life history strategy (Cordoleani *et al.* 2021). This results in a lower number of large juveniles out-migrating to the ocean much later in the year. When the dry condition cohort returns as adults, there are fewer adults because there was less survival during the large spring outmigration. Therefore, the number of adult spawners is likely to be lower from a juvenile cohort that experienced drought conditions in freshwater during their out-migration, in contrast to a juvenile cohort that experienced high river flows during a wet water year while out-migrating.

**Viable Salmon Population Assessment**

The viability of CV spring-run Chinook salmon has deteriorated since the NMFS 2016 Status Review, with weakening of all independent CV spring-run Chinook salmon populations (Johnson *et al*. 2023). The total estimated abundance of adult CV spring-run Chinook salmon for the Sacramento River watershed in 2019 was 26,553, approximately half of the population size in 2014 (N=56,023). Also, population sizes have hit decadal lows, of ~14,000 individuals recently (Johnson *et al*. 2023).

The CV spring-run Chinook salmon ESU includes all naturally spawned CV spring-run Chinook salmon originating from the Sacramento River and its tributaries (70 FR 37159, June 28, 2005). In 2014, FRFH broodstock was used to actively reintroduce CV spring-run Chinook salmon into the mainstem San Joaquin River as an ESA 10(j) experimental population (NMFS 2013). Since 2019, adults have been observed returning to the San Joaquin River and successfully spawning within the San Joaquin River Restoration Program Restoration Area. There have also been observations of CV spring-run Chinook salmon returning to the San Joaquin River tributaries. This ESU does not include Chinook salmon that are designated as part of the San Joaquin River experimental population (Johnson *et al*. 2023).

Historically, the CV spring-run Chinook salmon ESU was composed of four Diversity Groups: Basalt and Porous Lava, Northwestern California, Northern Sierra Nevada, and Southern Sierra Nevada. Recovery criteria outlined in the NMFS CV salmonid recovery plan (NMFS 2014a) are targeted on achieving, at a minimum, the biological viability criteria for each major diversity group in the ESU in order to have all four diversity strata at viable (low risk) status with representation of all the major life history strategies present historically, and with the abundance, productivity, spatial structure, and diversity attributes required for long-term persistence.

In order to meet the recovery criteria for this ESU and thereby delist the species, there must be at least nine populations at a low risk of extinction distributed throughout the Central Valley, as well as additional core 2 populations.

- One population in the Northwestern California Diversity Group at low risk of extinction
- Two populations in the Basalt and Porous Lava Diversity Group at low risk of extinction
- Four populations in the Northern Sierra Nevada Diversity Group at low risk of extinction
- Two populations in the Southern Sierra Nevada Diversity Group at low risk of extinction

None of the four diversity groups currently meet the number of viable/independent populations at a low risk of extinction needed to meet recovery criteria (Johnson *et al*. 2023).

*Spatial Structure and Diversity*

At the ESU level, the spatial diversity is increasing and CV spring-run Chinook salmon are present (albeit at low numbers in some cases) in all diversity groups. The reestablishment of CV spring-run Chinook salmon to Battle Creek and increasing abundance of CV spring-run Chinook salmon on Clear Creek observed in some years is benefiting the viability of CV spring-run Chinook salmon. Similarly, the reappearance of early migrating Chinook salmon to the San Joaquin River tributaries may be the beginning of natural dispersal processes into rivers where they were once extirpated. While the spatial diversity expanding is a positive indicator for the ESU, populations have still declined sharply in recent years to in most cases worryingly low levels of abundance.

The ESU is trending in a positive spatial direction towards achieving at least two populations in each of the four historical diversity groups necessary for recovery with the Northern Sierra Nevada region (NMFS 2014a). There have been recent observations of CV spring-run Chinook salmon returning to the San Joaquin River tributaries and creating redds. The ESU does not currently include Chinook salmon that are designated as part of the San Joaquin River experimental population, however strays from Sacramento River populations are part of the Central Valley ESU. Continuing to monitor these populations will provide valuable data to evaluate the status of CV spring-run Chinook salmon in the San Joaquin River and its tributaries. This monitoring would also provide a basis for evaluating whether the ESU boundary should be modified to account for CV spring-run Chinook salmon populations repopulating the San Joaquin River Basin and/or in CV habitats upstream of currently impassable barriers.

*Abundance and Productivity*

Most Core 2 CV spring-run Chinook salmon populations have been experiencing continued and, in some cases drastic, declines. In 2015, CV spring-run Chinook salmon showed strong signs of repopulating Battle Creek, home to a historical independent population in the Basalt and Porous Lava diversity group that had been extirpated for many decades (NMFS 2016, Johnson *et al*. 2023). Current viability metrics show a significant declining trend (23% decline per year) and low population size (N<250) for the Battle Creek spring-run Chinook salmon population, placing it at a high extinction risk (Johnson *et al*. 2023). Similarly, the CV spring-run Chinook salmon population in Clear Creek, previously identified as increasing in abundance, has experienced recent declines in population size (N=136) down from N=822 in 2015, placing it at a high risk of extinction (Johnson *et al*. 2023). Mill Creek and Deer Creek spring-run Chinook salmon populations reached low population sizes (N=590 and N=956, respectively) placing them at a moderate risk of extinction (Johnson *et al*. 2023). Yet, the low run sizes in consecutive years for Mill Creek spring-run Chinook salmon following the recent droughts (~150 individuals) and precipitous decline (16% over the decade) place Mill Creek at a high risk of extinction using the VSP criteria (Johnson *et al*. 2023). The highest risk score for any criterion determines the overall extinction risk for a given population. Recent declines of population size in all populations have been substantial and almost qualify as catastrophes under the criteria (>90% decline) with the main independent populations of CV spring-run Chinook salmon reaching all-time declines over one generation (Battle Creek = 77%, Butte Creek = 76%, Deer Creek = 84%, and Mill Creek = 68%) (Johnson *et al*. 2023).

Counteracting recent declines in the abundance of adults from dependent populations, CV spring-run Chinook salmon have continued to repopulate areas where they were once extirpated, including Battle and Clear Creeks, and more recently the San Joaquin River. Each of these watersheds have the potential to support independent and viable CV spring-run Chinook salmon populations (NMFS 2014a; Lindley *et al*. 2004). CV spring-run Chinook salmon ESU populations have experienced a series of droughts over the past decade. From 2007–2009 and 2012–2016, the Central Valley experienced drought conditions and low river and stream discharges, which are strongly associated with lower survival of Chinook salmon (Michel *et al.* 2015).

A new emerging threat to the CV spring-run Chinook salmon populations includes thiamine deficiency, which was responsible for early life stage mortality of FRFH spring-run Chinook salmon in the hatchery in recent years, initially being diagnosed in 2019 (Mantua *et al*. 2021). Direct mortality or latent effects that would lead to increased mortality in that cohort would not be able to begin being detected until the dominant age class of 3-year-olds from the affected years return to spawn (starting in 2022), and further data can be analyzed for annual adult escapements to determine further effects on the population and viability. Starting in 2019, significant numbers of juvenile mortalities were observed in the Feather River rotary screw trap, early in the juvenile out-migration season, consistent with thiamine deficiency complex (TDC) observed in the hatchery. In fact, significantly fewer juveniles were observed in 2019 (N=1149) compared to 2018 (N=30,334), and 45% of juveniles in 2019 were found dead compared to 1% observed in 2018 (Johnson *et al*. 2023). It is unclear the extent to which this was a basin-wide nutritional deficiency for all CV spring-run Chinook salmon spawning in 2019.

**Central Valley Spring-run Chinook salmon critical habitat**

Critical habitat was designated for the CV spring-run Chinook salmon ESU on September 2, 2005 (70 FR 52488). The geographical range of designated critical habitat for CV spring-run Chinook salmon includes stream reaches of the Feather, Yuba, and American rivers; Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks; and the Sacramento River downstream to the Delta, as well as portions of the northern Delta (70 FR 52488).

As a result of human-made barriers to migration, especially the construction of major dams, CV spring-run Chinook salmon have been confined to lower elevation river mainstems that historically only were used for migration. The greatly reduced spawning and rearing habitat has resulted in declines in population abundances in these streams. Additionally, the remaining habitat is of lower quality, in particular because of higher water temperatures in late summer and fall, reduced gravel recruitment, and lack of instream large woody material (LWM).

The critical habitat designation for CV spring-run Chinook salmon lists the essential physical and biological features ((70 FR 52488); September 2, 2005), which include:

1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development,
2) Freshwater rearing sites with: (i) water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) water quality and forage supporting juvenile development; and (iii) natural cover, such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks,
3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover, such as submerged and overhanging

large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival, and

4) Estuarine areas free of obstruction and excessive predation with: (i) water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) natural cover, such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

The current condition of CV spring-run Chinook salmon critical habitat PBFs have been degraded from their historical condition within the action area. Although there are exceptions, the majority of streams and rivers in the ESU have impaired habitat. Additionally, critical habitat in the ESU often lacks the ability to establish essential features due to ongoing human activities. Large dams, like Shasta Dam on the Sacramento River, stop the recruitment of spawning gravels, which impact both an essential habitat type (spawning areas) as well as an essential feature of spawning areas (substrate). Water utilization in many regions throughout the ESU reduces summer base flows, which limits the establishment of several essential features, such as water quality and water quantity.

In the Sacramento River and adjacent tributaries, bank armoring has significantly reduced the quantity of floodplain rearing habitat for juvenile salmonids and has altered the natural geomorphology of the river (NMFS 2014a). CV spring-run Chinook salmon are only able to access large floodplain areas, such as the Yolo Bypass, under certain hydrologic conditions which do not occur in drier years. 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).

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.

**Summary**

To conclude, the viability of the CV spring-run Chinook salmon ESU has deteriorated since it was listed under the ESA (NMFS 2016, Johnson et al. 2023). The largest impacts are likely due to the 2012-2015 and 2020-2022 freshwater drought conditions and unusually warm ocean conditions experienced by these cohorts. This ESU continues to face significant, unyielding threats that are likely to be exacerbated by the impacts of future climate change. According to the viability report, there has been a decrease in the viability and the ESU remains at a moderate to high risk of extinction (Johnson et al. 2023). The viability of the ESU has decreased, and the threats to the species' persistence remain high and are not improving (Johnson et al. 2023).

### 2.2.3. California Central Valley Steelhead

**Introduction and Background**

The California Central Valley (CCV) steelhead DPS includes CCV steelhead spawning naturally in the Sacramento and San Joaquin Rivers and their tributaries, as well as CCV steelhead that are part of the hatchery program at CNFH and FRFH (70 FR 37204).

In 1998, NMFS listed CCV steelhead under the ESA and classified it as a threatened species. In 2006, following the development of NMFS' Hatchery Listing Policy (70 FR 37204, June 28, 2005), we re-evaluated the status of this DPS and determined that the DPS continued to warrant listing as a threatened species. Furthermore, we determined that the CNFH and FRFH stocks of CCV steelhead should be part of the DPS.

CCV steelhead historically occurred naturally throughout the Sacramento and San Joaquin River basins, although stocks have been extirpated from large areas above dams or instream in both basins. In 1988 the California Advisory Committee on Salmon and Steelhead reported a reduction in freshwater CCV steelhead habitat from 6,000 linear miles historically to 300 linear miles of stream habitat.

**Life History**

CCV steelhead exhibit perhaps the most complex suite of life-history traits of any species of Pacific salmonid. Members of this species can be anadromous or freshwater residents and, under some circumstances, members of one form can yield offspring of another form.

Adult migration from the ocean to spawning grounds occurs during much of the year, with peak migration occurring in the fall or early winter. CCV steelhead generally begin spawning in December, continuing through March/April.

CCV steelhead spawn downstream of dams on every major tributary within the Sacramento and San Joaquin River systems. Due to water development projects, most spawning is now confined to lower stream reaches below dams. In a few streams, such as Mill and Deer creeks, CCV steelhead still have access to historical spawning areas (NMFS 2014a).

Spawning occurs mainly in gravel substrates (particle size range of about 0.2−4.0 inches). Adults tend to spawn in shallow areas (6−24 inches deep) with moderate water velocities (about 1 to 3.6 feet per second) (Hannon and Deason 2007). Unlike Chinook salmon, CCV steelhead may not die after spawning (McEwan and Jackson 1996). Some may return to the ocean and repeat the spawning cycle for two or three years. The percentage of adults surviving spawning is generally thought to be low for CCV steelhead, but varies annually and between stocks. Acoustic tagging of CCV steelhead kelts from the CNFH indicates survival rates can be high, especially for CCV steelhead reconditioned by holding and feeding at the hatchery prior to release. Some return immediately to the ocean and some remain and rear in the Sacramento River (NMFS 2009). Recent studies have shown that kelts may remain in freshwater for an entire year after spawning (Teo et al. 2013), but that most return to the ocean.

CCV adult steelhead eggs incubate within the gravel and hatch from approximately 19 to 80 days at water temperatures ranging from 60°F to 40°F, respectively (NMFS 2009). After hatching, the young fish (alevins) remain in the gravel for an extra two to six weeks before emerging from the gravel and taking up residence in the shallow margins of the stream.

Steelhead embryo incubation generally occurs from December through June in the Central Valley. Steelhead eggs reportedly have the highest survival rates at water temperature ranges of 44.6°F to 50.0°F (Myrick and Cech 2001). A sharp decrease in survival has been reported for O. mykiss embryos incubated above 57.2°F (Kamler and Kato 1983). After hatching, alevins remain in the gravel for an additional two to five weeks while absorbing their yolk sacs, and emerge in spring or early summer (Barnhart 1986).

The newly emerged juveniles move to shallow, protected areas associated within the stream margin (McEwan and Jackson 1996). Productive juvenile rearing habitat is characterized by complexity, primarily in the form of cover, which can be deep pools, woody debris, aquatic vegetation, or boulders. Cover is an important habitat component for juvenile CCV steelhead both as velocity refugia and as a means of avoiding predation (Bjornn and Reiser 1991). Older juveniles use riffles and larger juveniles may also use pools and deeper runs (Barnhart 1986 as cited in McEwan and Jackson 1996). However, specific depths and habitats used by juvenile rainbow trout can be affected by predation risk. An upper water temperature limit of 65°F is preferred for growth and development of Sacramento River and American River juvenile steelhead (NMFS 2014a).

Most juvenile CCV steelhead spend one to three years in fresh water before emigrating to the ocean as smolts (Shapovalov and Taft 1954). The primary period of CCV steelhead smolt outmigration from rivers and creeks to the ocean generally occurs from January to June (NMFS 2009). CCV steelhead successfully smolt at water temperatures in the 43.7°F to 52.3°F range (Myrick and Cech 2001). In the Sacramento River, juvenile CCV steelhead migrate to the ocean in spring and early summer at one to three years of age with peak migration through the Delta in March and April (Reynolds 1993).

**CCV steelhead Viability Status Assessment**

Good *et al.* (2005) found that the CCV steelhead DPS was in danger of extinction, with a minority of the Biological Review Team (BRT) viewing the DPS as likely to become endangered. The BRT's major concerns were the low abundance of natural-origin anadromous *O. mykiss,* the lack of population-level abundance data, and the lack of any information to suggest that the decline in CCV steelhead abundance evident from 1967–1993 dams counts had stopped.

Using data through 2005, Lindley *et al*. (2007) found that data were insufficient to determine the viability 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.

The proportion of hatchery-origin fish in the Battle Creek returns averaged 29% over the 2002–2010 period, elevating the level of hatchery influence to a moderate risk of extinction. The Chipps Island midwater trawl dataset of USFWS indicated that the decline in natural production of CCV steelhead had continued unabated through 2010, with the proportion of adipose fin-clipped steelhead reaching 95%. In 2015, population trend data showed significant increases in abundance of CNFH and FRFH populations, but data are still lacking to estimate trends in natural populations.

The Central Valley Salmon and Steelhead Recovery Plan (NMFS 2014a) includes biological recovery criteria based on the viable salmonid population concept. The Central Valley Salmon and Steelhead Recovery Plan includes the following recovery criteria:

DPS level criteria:

- One population in the Northwestern California Diversity Group at low risk of extinction
- Two populations in the Basalt and Porous Lava Diversity Group at low risk of extinction
- Four populations in the Northern Sierra Diversity Group at low risk of extinction
- Two populations in the Southern Sierra Diversity Group at low risk of extinction
- Maintain multiple populations at moderate risk of extinction

In order to meet the recovery criteria for this DPS and thereby delist the species, there must be at least nine populations at a low risk of extinction distributed throughout the Central Valley as outlined above, as well as additional populations at a moderate risk of extinction (NMFS 2014a). Currently, no CCV steelhead populations satisfy the low extinction risk criteria. For the 17 populations evaluated, 11 are at high extinction risk and 6 are at moderate extinction risk. The Battle Creek population is considered at Moderate risk of extinction (Johnson *et al*. 2023).

*Abundance and Productivity*

Population trend data remain extremely limited for the CCV steelhead DPS. The total hatchery populations from CNFH, FRFH, and MRH have significantly increased since the 2010 and 2015 viability assessments. In fact, CNFH returns have steadily increased 15% per year over the last decade.

The American River steelhead population has experienced a precipitous decline since 2003, resulting in a moderate risk of extinction. It should be noted that a significant proportion of steelhead redds on the American River are made by NH steelhead, which are not part of the DPS, and declined 8% per year over the last decade.

Looking broader than the individual population level, Chipps Island midwater trawl data provide information on the trend in abundance for the CCV steelhead DPS as a whole. Updated through 2019, the trawl data indicate that the production of natural-origin steelhead remains very low relative to hatchery production. The lack of improved natural production as estimated by juvenile migrants exiting the river systems at Chipps Island, and low abundances coupled with large hatchery influence is cause for concern.

Catch-per-unit effort has fluctuated and generally increased over the past decade, but the proportion of the catch that is adipose fin-clipped (100% of hatchery steelhead production have been adipose fin-clipped starting in 1998) has increased steadily, exceeding 90% in recent years and reaching 96% during the drought in 2015. This suggests that the vast majority of CCV steelhead out-migrating from the Sacramento-San Joaquin Delta (Delta) are of hatchery-origin.

*Spatial Structure and Diversity*

This DPS includes CCV steelhead populations spawning in the Sacramento and San Joaquin rivers and their tributaries. Populations upstream of migration barriers remain excluded from this DPS. Hatchery stocks within the DPS include CNFH, FRFH, and Mokelumne River Hatchery (MRH). Genetic analysis showed that the steelhead stock propagated in the MRH was genetically similar to the steelhead broodstock in the FRFH (Pearse and Garza 2015), consistent with documentation on the recent transfers of eggs from the FRFH for broodstock at the MRH. The Nimbus Hatchery (NH) steelhead remain genetically divergent from the Central Valley DPS lineages, consistent with their founding from coastal steelhead stocks, and remain excluded from the DPS (Pearse and Garza 2015).

As overall data remain extremely limited for the CCV steelhead DPS, it is difficult to ascertain if their spatial distribution has changed. From recent monitoring data, steelhead are not noted to have had any substantial changes in spatial distribution or diversity. Hatchery influence continues to be a high threat to diversity of the DPS, and the out of basin stock at Nimbus Hatchery poses significant genetic threat to CCV steelhead (Johnson *et al*. 2023).

**California Central Valley steelhead critical habitat**

On February 16, 2000, (65 FR 7764), NMFS published a final rule designating critical habitat for CCV steelhead. This critical habitat includes all river reaches accessible to listed CCV steelhead in the Sacramento and San Joaquin rivers and their tributaries in California. NMFS proposed new Critical Habitat for CCV steelhead on December 10, 2004, (69 FR 71880) and published a final rule designating critical habitat for these species on September 2, 2005.

Critical habitat for CCV steelhead includes stream reaches, such as those of the Sacramento, Feather, and Yuba Rivers; Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the San Joaquin River, including its tributaries; and the waterways of the Delta. Currently, the CCV steelhead DPS and critical habitat extends up the San Joaquin River up to the confluence with the Merced River. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line.

The critical habitat for CCV steelhead lists the essential PBFs ((70 FR 52488); September 2, 2005), which include:

1) Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development,
2) Freshwater rearing sites with: (i) water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (ii) water

quality and forage supporting juvenile development; and (iii) natural cover, such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks,

3) Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover, such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival, and
4) Estuarine areas free of obstruction and excessive predation with: (i) water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; (ii) natural cover, such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and (iii) juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Historically, CCV steelhead spawned in many of the headwaters and upstream portions of the Sacramento River and San Joaquin River basins. Passage impediments have contributed to substantial reductions in the populations of these species by isolating them from much of their historical spawning habitat. The current condition of CCV steelhead critical habitat PBFs have been degraded from their historical condition within the action area. The majority of streams and rivers in the DPS have impaired habitat. Additionally, critical habitat often lacks the ability to re-establish essential features due to ongoing human activities. Water utilization in many regions throughout the DPS reduces summer base flows, which limits the establishment of several essential features such as water quality and water quantity.

Freshwater rearing and migration PBFs have been degraded from their historical condition within the action area. In the Sacramento and San Joaquin rivers, bank armoring has significantly reduced the quantity of floodplain rearing habitat for juvenile salmonids and has altered the natural geomorphology of the river (NMFS 2014a). Similar to SR winter-run Chinook salmon, CCV steelhead are only able to access large floodplain areas, such as the Yolo Bypass, under certain hydrologic conditions that do not occur in drier years. 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).

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 watershed and the Delta are considered to have high intrinsic value for the conservation of the species as they are critical to ongoing recovery efforts.

**Summary**

Based upon the limited information available, the overall viability of the CCV steelhead DPS appears to be unchanged since the NMFS 5-year review (NMFS 2016). However, the majority (11 of 16) of populations for which data exists are at a high risk of extinction based on abundance and/or hatchery influence. No population is currently considered to be at a low risk of extinction. The lack of improved natural production estimates, and low abundances coupled with large hatchery influence are causes for continued concern (Johnson *et al*. 2023).

### 2.2.4. Southern Distinct Population Segment (sDPS) Green Sturgeon

#### Introduction and Life-History

In 2006 NMFS listed the Southern Disinct Population Segment of North American Green Sturgeon (*Acipenser medirostris)* under the ESA and classified it as threatened species (April 7, 2006, 71 FR 17757). Southern DPS 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. (2009) 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. 2009, Cramer Fish Sciences 2011, Seesholtz et al. 2014). It is unlikely that sDPS 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 sDPS green sturgeon, and adult spawning has not been documented there (Jackson and Eenennaam 2013).

#### Viability Status

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 (Cramer Fish Sciences 2011, Seesholtz et al. 2014). Concentration of adults into a very few select spawning locations makes the species highly vulnerable to poaching and catastrophic events. 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 2023). Lindley et al. (2007), in discussing SR winter-run Chinook salmon, state 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 sDPS population estimate was developed by Mora et al. (2018) through Dual Frequency Identification Sonar (DIDSON) surveys of aggregation sites conducted from 2010-2015 in the upper Sacramento River. Mora et al. (2018) estimated the total population size to be 17,548 individuals (95% confidence interval [CI] = 12,614-22,482). The SWFSC recently updated the total population estimate to 17,723 (Dudley 2021). The DIDSON surveys and associated modeling will eventually provide population trend data. This estimate does not include the number of spawning adults in the lower Feather or Yuba rivers, where green sturgeon spawning was confirmed (Seesholtz et al. 2014). A decrease in sDPS green sturgeon abundance has been inferred from the amount of take observed at the south Delta pumping facilities of the Central Valley Project (CVP) and the State Water Project (SWP). These data should be interpreted with some caution. Operations and practices at the facilities have changed through time, 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.

The parameters of sDPS green sturgeon population growth rate and carrying capacity in the Sacramento River Basin are poorly understood. Larval count data show 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 2023). 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. Since the ceasing of operations of seasonal gates at the Red Bluff Division Dam (RBDD), Southern DPS green sturgeon are able to access spawning habitat upstream of RBDD (Mora et al. 2018, Steel et al. 2019). 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 2023). 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.

According to Dudley et al. (2024), adult green sturgeon demonstrated an average spawning interval of 4.2 years for females and 3.8 years for all fish, meaning adults would return to spawn about every 4 years. A previous study by Mora et al. estimated the population size to be 17,548 individuals, with 2,106 adults, 11,055 subadults, and 4,387 juveniles (NMFS 2021). A more recent study by Dudley et al. (2024) estimated the total population size in 2018 to be 10,700 individuals (with a 95% highest density interval (HDI) between 5,300 and 18,400 individuals), with 2,400 adults (2197-2624 95% HDI).

## sDPS Green Sturgeon Critical Habitat

The critical habitat designation for sDPS green sturgeon (74 FR 52300, October 9, 2009) lists the PBFs for both freshwater riverine systems and estuarine habitats as: 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.

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 sDPS 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.

**Summary**

The 5-year status review for sDPS green sturgeon found that some threats to the species have been eliminated, such as harvest from commercial fisheries and removal of some passage barriers (NMFS 2023). Since many of the threats cited in the original listing still exist, the threatened status of the DPS is still applicable (NMFS 2023). 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 2023). 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 2023).

### 2.2.5. Current Limiting Factors

The following are current limiting factors for the listed species' population numbers included in this consultation:

- Dams block access to historical spawning and summer holding areas along with altering river flow regimes and temperatures (up to 90 percent for SR winter-run and CV spring-run Chinook salmon).
- Water management/diversions/barriers
- Loss of floodplain rearing habitat (levees/bank protection)
- Urbanization and rural development
- Logging
- Grazing
- Agriculture
- Mining – historic hydraulic mining from the California Gold Rush era
- Estuarine modified and degraded, thus reducing developmental opportunities for juvenile salmonids
- Predation
- Dredging and sediment disposal
- Contaminants
- Altering prey base for fish
- Fisheries
- Hatcheries
- "Natural" factors (i.e., ocean conditions)
- Climate change exacerbating flow and water temperature related impacts (see below for more detail)

### 2.2.6. Global Climate Change

The globally-averaged combined land and ocean surface temperature data, as calculated by a linear trend, show a warming of approximately 1°C (1.8°F) from 1901 through 2016 (USGRCP 2018). The *IPCC Special Report on the Impacts of Global Warming* (IPCC 2023) noted that human-induced warming reached a global surface temperature of 1.1°C (2.0°F) above pre-industrial levels by 2020, and global surface temperature has increased faster since 1970 than in any other 50-year period over at least the last 2000 years. Overall, annual average temperatures have increased by 1.8°C (3.2°F) across the contiguous United States since the beginning of the 20th century, with Alaska warming faster than any other state and twice as fast as the global average since the mid-20th century (Jay et al. 2018). Global warming has also led to more frequent heat waves in most land regions and an increase in the frequency and duration of marine heatwaves (IPCC 2023). Average global warming up to 1.5°C (2.7°F) as compared to pre-industrial levels is expected to lead to regional changes in extreme temperatures and increases in the frequency and intensity of precipitation and drought (IPCC 2023).

From 2012 to 2016, California experienced the most extreme drought since instrumental records began in 1895. A growing body of evidence suggests that climate change has increased the likelihood of extreme droughts in California (Durrand et al. 2020). California experienced well below average precipitation during the 2012-2016 drought, as well as record high surface air temperatures in 2014 and 2015, and record low snowpack in 2015 (Williams et al. 2020). Paleoclimate reconstructions suggest the 2012-2016 drought was the most extreme in the past 500 to 1000 years (Williams et al. 2019, Williams et al. 2020, Williams et al. 2022). Anomalously high surface temperatures substantially amplified annual water deficits during 2012-2016. California entered another period of drought in 2020-2022, the effects of which are still being realized. These drought periods are now likely part of a larger drought event (Williams et al. 2022). This recent long-term drought, as well as the increased incidence and magnitude of wildfires in California, have likely been exacerbated by climate change (Williams et al. 2020, Williams et al. 2022, Durrand et al. 2020, Williams et al. 2019).

Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of 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 and of greater magnitude 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 to July has been decreasing since about 1950 (Roos 1987, 1991). Increased temperatures influence the timing and magnitude patterns of the hydrograph and strain the ability of reservoir water managers to control flood flows and downstream conditions.

The magnitude of snowpack reductions is subject to annual variability in precipitation and air temperature. Large spring snow water equivalent 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 snow water equivalent (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 snow water equivalent (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 relatively shallow, and thereby reducing the spring/summer flows in that watershed.

For SR winter-run Chinook salmon, the embryonic and larval life stages that are most vulnerable to warmer water temperatures occur during the summer, so this run is particularly at risk from climate warming. The only remaining population of SR winter-run Chinook salmon relies on the cold-water pool in Shasta Reservoir that buffers the effects of warm temperatures in most years. The exception occurs during drought years that are predicted to occur more often with climate change (Yates et al. 2008). Additionally, air temperature appears to be increasing at a greater rate than previously analyzed (Beechie et al. 2012, Dimacali 2013). These factors will compromise the quantity and/or quality of SR winter-run Chinook salmon habitat available downstream of Keswick Dam.

CV spring-run Chinook salmon adults are vulnerable to climate change, because they over-summer in freshwater streams before spawning in autumn (Thompson et al. 2012). 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.

CCV 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 CCV 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 CCV steelhead, which range from 14°C to 19°C (57°F to 66°F).

Adult sDPS green sturgeon have been observed as far upstream as the Anderson-Cottonwood Irrigation District (ACID) Dam, which is considered the upriver extent of sDPS green sturgeon passage in the Sacramento River (Heublein et al. 2009). However, sDPS green sturgeon spawning occurs approximately 30 kilometers (18.6 miles) downriver of the ACID Dam where water temperature is warmer than at the ACID Dam during late spring and summer. If water temperatures increase with climate change, temperatures at spawning locations below the ACID Dam may be above tolerable levels for the embryonic and larval life stages of sDPS green sturgeon.

In summary, observed and predicted climate change effects are generally detrimental to all of the listed anadromous fish species, so unless offset by improvements in other factors, the status of the species and critical habitat is likely to further decline over time. The climate change projections referenced above cover the time period between the present and approximately 2100 and, while there is uncertainty associated with the precision of projections, the increasing trend is certain (McClure et al. 2013).

## 2.3. Action Area

"Action area" means all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). The Action Area for this section 7 consultation encompasses all areas that may be directly or indirectly affected as a result of activities for ARCF project and the broader area that, while outside the construction zone, may be directly or indirectly affected by implementation of the Proposed Action, such as vibrations, noise, increased turbidity, or sedimentation movement associated with the proposed cacheaction. This includes all areas that will be affected in the short-term and long-term, by the construction and maintenance for the remaining ARCF project. Locations for each of the remaining ARCF proposed project locations can be found in Figure 5.

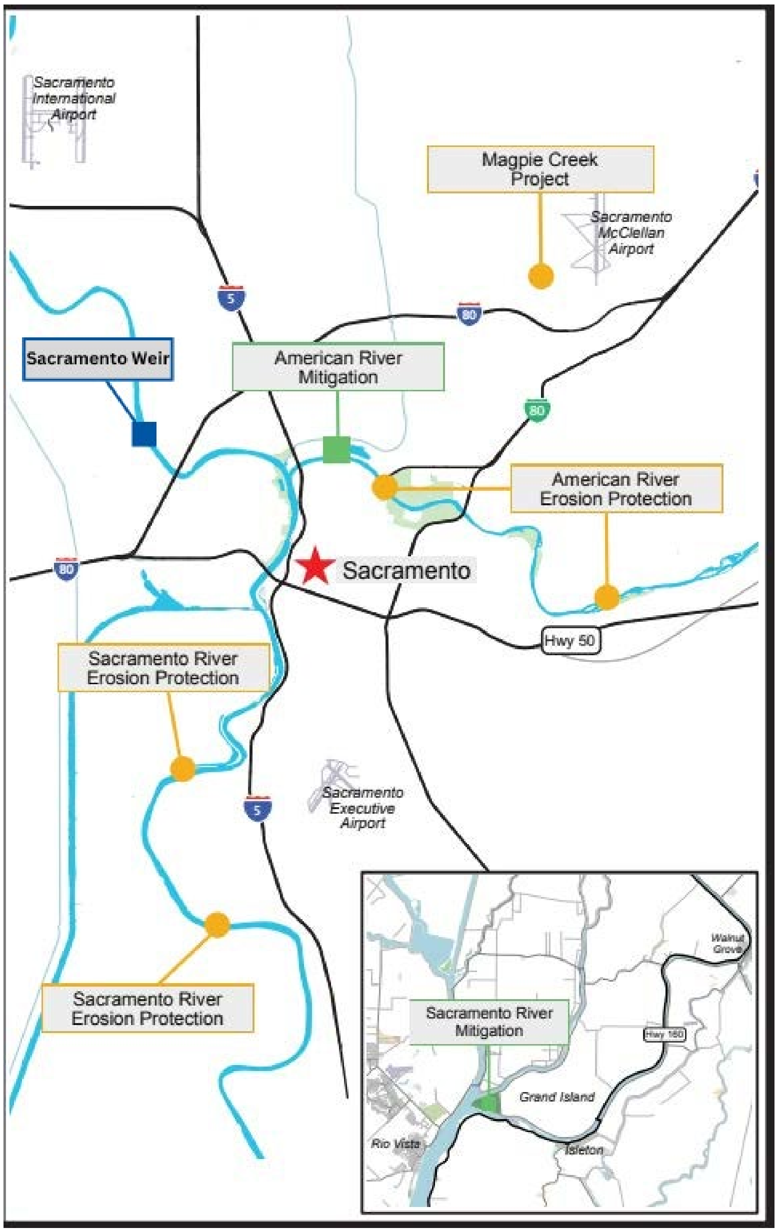



**Figure 5. Locations of Remaining ARCF Proposed Actions (Source: USACE BA 2024)**

The Action Area encompasses areas along the Sacramento River from the Sacramento Bypass downstream to RM 45, the Yolo Bypass south the confluence of the Sacramento Bypass, the lower American River RM 11 downstream to the confluence with the Sacramento River, and other haul, access, and borrow sites associated with construction activities. Vessel traffic for construction material hauling may extend as far west as San Francisco in order to transport material to sites along the Sacramento River.

The Action Area also includes any areas that may be affected by the implementation of conservation measures, including compensatory mitigation and planting areas. The ARMS action area (located at American River RM 1.0) is encompassed by the previously described action area within the lower American River. The SRMS action area encompasses the approximately 200-acre area of Grand Island located near Sacramento RM 15 at the confluence of Cache and Steamboat Sloughs and the adjacent waterways which may be subject to project effects.

In addition, the proposed action includes the potential purchase bank credits to offset permanent habitat impacts which may remain unmitigated following completion of the ARMS and SRMS sites. USACE has not specified from which bank credits will be purchased. Therefore, we include all mitigation banks that service the project locations and offer credits to offset these habitat types in the action area for the proposed action.

- North Delta Fish Conservation Bank: an 811-acre site located on Liberty Island within the Yolo Bypass that provides tidal marsh complex, tidal channel, open-water, tule SRA and riparian SRA habitat. The 811-acre restoration site is included in the action area of the proposed action.

## 2.4. Environmental Baseline

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

This section describes the physical conditions and general vegetation, wildlife, and fisheries resources present within the ARCF Action Area. These conditions are first presented generally throughout the ARCF Action Area and then site specific SRA is analyzed as well as affected species in the ARCF Action Area.

The Sacramento River watershed receives winter/early spring precipitation in the form of rain and snow (at higher elevations). Prior to the construction and operation of any reservoirs, winter rainfall events caused extensive flooding and spring snowmelt resulted in high flows during spring and early summer. Summer and fall flows were historically low. Currently, much of the total runoff is captured and stored in reservoirs for gradual release during the summer and fall months. High river flows occur during the winter and spring, but these are usually lower than during pre-European settlement times; summer and fall low flows are sustained by releases from upstream reservoirs.

Downstream from the American River confluence, the Sacramento River is moderately sinuous (average sinuosity of 1.3), with the channel confined on both sides by man-made levees enhanced by decades of man-made additions. The channel in this reach is of uniform width, is not able to migrate, and is typically narrower and deeper relative to the upstream reach due to scour caused by the concentration of shear forces acting against the channel bed (Brice 1977). Channel migration is similarly limited along the lower American River because of man-made levees and regulated flows from Folsom Dam.

The natural banks and adjacent floodplains of both rivers are composed of silt- to gravel-sized particles with poor to high permeability. Historically, the flow regimes caused the deposition of a gradient of coarser to finer material, and longitudinal fining directed downstream (sand to bay muds). The deposition of these alluvial soils historically accumulated to form extensive natural levees and splays along the rivers, 5 to 20 feet above the floodplain for as far as 10 miles from the channel (Thompson 1961). The present-day channels consist of fine-grained cohesive banks that erode due to natural processes as well as high flow events (USACE 2012).

Most existing habitat impacts are the result of development of the basin-wide flood control system, the SRFCP (Sacramento River Flood Control Project), and other human developments. The current system evolved from private efforts begun in 1850 into the joint Federal-State SRFCP, which was essentially completed in 1960. Because the SRFCP removed large acreages of riparian floodplain and overflow basins from the river system, the natural regeneration of riparian woodland communities was negatively impacted. Additional effects occurred to recruitment of large woody material to the river system, spawning and rearing of fish in floodplain and floodplain functions, and allochthonous (imported) input of nutrients and food to the aquatic system. The SRFCP largely eliminated the possibility of natural channel migration and habitat renewal over a considerable portion of the river system. Reaches throughout the action area historically provided both shallow and deeper water habitat. However, channel confining levees and upstream reservoirs that maintain year-round outflow have eliminated much of the adjacent shallow water floodplain habitat. The existing levees influence the natural meander and ecosystem of the Sacramento and American Rivers, included in the action area. Many native fish species are adapted to rear in flooded, shallow water areas that provide abundant cover from prey. As a consequence of habitat alterations, and introduction of non-native species and pollutants, some native fish species are now extinct while most others are reduced in numbers (Moyle 2002).

The Proposed Action is occurring in the Sacramento River and American River which serve as rearing habitat and migratory corridors for listed SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. As mentioned above, much of the Sacramento and American River watersheds have been substantially altered from human activities, and this has dramatically reduced the habitat value of the watersheds for listed fish species. However, despite the impaired status of the Sacramento River watershed in the proposed action area, the value of the area for listed fish species is high, as it provides some of the last remaining critical habitat for listed fish. The lower Sacramento River is the essential migratory corridor for all SR winter-run Chinook salmon, and the majority of CV spring-run Chinook salmon populations, CCV steelhead populations, and sDPS green sturgeon, and contains habitat elements that support the rearing and growth of juveniles and the successful upstream migration of adults. The same high value habitat can be attributed to the lower American River for CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon.

Seasonal high flows enter the adjacent Yolo Bypass from this reach of the Sacramento River via the Sacramento Bypass (RM 63). Tidal influence emanating from Suisun Bay extends up the Sacramento River for 80 miles to Verona, with greater tidal variations occurring downstream during low river stages in summer and fall.

**Vegetation in the Action Area**

The Action Area consists of primarily riparian forest, valley oak woodland, riparian scrub-shrub habitat, and typically non-native annual grassland. Scrub-shrub generally refers to areas where the woody riparian canopy is composed of young trees or shrubs less than 20 feet high. Species that are typically found in riparian forest, valley oak woodland, and scrub habitats include cottonwood, several willow species, sycamore valley oak, black walnut, Oregon ash, white alder, boxelder, blue elderberry, buttonbush, Himalaya blackberry, wild grape, and poison oak. Understory vegetation may consist of an herbaceous layer of sedges, rushes, grasses, and forbs.

Riparian forest typically has a dominant overstory of cottonwood, California sycamore, black walnut, black willow, or valley oak. Dominant species found in the sub canopy may also include alder, ash and box elder. Layers of climbing vegetation make up part of the subcanopy, with wild grape being a major component, but wild cucumber and clematis vines are also found in riparian communities. Several species of invasive non-native trees, shrubs and vines may be present in some riparian locations, predominantly red sesbania, Himalayan blackberry, tamarix, false bamboo, tree-of-heaven, eucalyptus, and ivy.

The herbaceous ruderal groundcover, primarily nonnative annual grassland, is found on most levees along the Sacramento River. It occurs on the levees and also within gaps in the riparian habitats. Plant species include wild oats, soft chess, ripgut brome, red brome, wild barley, Bermuda grass, and foxtail fescue. Common forbs include broadleaf filaree, red stem filaree, turkey mullein, clovers, and many others. The majority of these plants are not native to the Action Area.

Early riparian habitat may be called scrub-shrub. Scrub-shrub generally refers to areas where woody riparian canopy is composed of trees or shrubs approximately 20 feet high. Species that are typically found in these habitats include young cottonwood (*Populus trichocarpa*), willow (*Salix spp*.), elderberry (*Sambucus spp.*), buttonbush (*Cephalanthus occidentalis*), Himalaya blackberry (*Rubus armeniacus*), wild grape (*Vitis vinifera*), and poison oak (*Toxicodendron spp*.).

Riparian herbaceous cover includes herbland cover and gravel and sand bar community types. Areas are designated as riparian herbaceous cover if they are enclosed by riparian vegetation or the stream channel. Gravel and sand bar community types were included in this grouping by the the USACE, because these areas support annual and short-lived perennial species, including herbs, grasses and subshrubs that cover less than 50% of the area (Nelson 2000). Species that are typically found in these habitats include European annual and native perennial grasses; native perennials, such as Douglas' sagewort (*Artemisia douglasiana*), Santa Barbara sedge (*Carex barbarae*), smooth horsetail (*Equisetum laevigatum*), California pea (*Lathyrus jepsonii var. californicus*) and cudweed (*Gnaphalium sp*.); non-native forbs and grasses, such as garden asparagus and Bermuda grass (*Cynodon dactylon*); and invasive plants, such as yellow star-thistle (*Centaurea solstitialis*). Monospecific stands of the invasive exotic giant reed (*Arundo donax*) are also included in this vegetation type category.

Emergent marsh includes valley freshwater marsh and common reed plant community types. Common species found in emergent marsh habitat include cattails (*Typha* spp.) and tule (*Scirpus spp.)* with some sedge or associated broad-leaved aquatic species (such as *Verbena hastata*), and common reed (*Phragmites australis*), which can grow in inundated areas along the channel edge.

Other cover types found in the action area include bare ground (areas devoid of vegetation), agricultural, ruderal vegetation (areas with sparse to moderate herbaceous plant cover dominated by weedy upland species), and urban (including structures, roads and parks, but are usually located on the landward side of the levee).

### Historical Human Resource Use and Current Riparian Vegetation

Historical precipitation and runoff patterns resulted in the Sacramento River being bordered by up to 500,000 acres of riparian forest, with valley oak woodland covering the higher river terraces (Katibah 1984). However, human activities of the 1800s and 1900s have substantially altered the hydrologic and fluvial geomorphic processes that create and maintain riparian forests within the Sacramento basin, resulting in both marked and subtle effects on riparian communities. Riparian recruitment and establishment models (Mahoney and Rood 1998; Bradley and Smith 1986) and empirical field studies (Scott et al. 1997, 1999) emphasize that hydrologic and fluvial processes play a central role in controlling the elevational and lateral extent of riparian plant species. These processes are especially important for pioneer species that establish in elevations close to the active channel, such as cottonwood and willows (*Salix* spp.). Failure of cottonwood recruitment and establishment is attributed to flow alterations by upstream dams (Roberts *et al.* 2001) and to isolation of the historic floodplain from the river channel. In addition, many of these formerly wide riparian corridors are now narrow and interrupted by levees and weirs. Finally, draining of wetlands, conversion of floodplains to agricultural fields, and intentional and unplanned introduction of exotic plant species have altered the composition and associated habitat functions of many of the riparian communities that are able to survive under current conditions.

*Site-Specific Analysis of Riparian Vegetation*

Analysis of total LF of SRA was conducted using Google Earth Pro for the reaches only associated with bank protection on the American and Sacramento Rivers in the ARCF Action Area (Table 2). However, site-specific conditions at proposed bank protection sites may evaluate SRA habitat values using the FHAST method of analysis to determine impacts and onsite compensation value based on actual designs. It is not anticipated that trees would need to be removed within the Sacramento Bypass as a result of the levee relocation effort, since the footprint of the expanded Bypass area is open farmland with no trees present. However, trees along the Sacramento River would be removed to construct the new 1,500-foot Sacramento Weir.

Below in Table 2 is the estimate of linear footage of existing riparian habitat along the reaches of the American and Sacramento Rivers where bank protection is expected to be constructed.

**Table 2 Summary of Reach Specific SRA Analysis from ARCF BA (USACE 2020)**

| Reach | **American River** | **Sacramento River** |
|---|---|---|
| **Linear Feet of SRA** | 45,367 | 51,804 |

### 2.4.1. Previous Flood Management within the Action Area

The environmental baseline also includes past and present flood management actions within the action area. This includes the portions of the ARCF project which have been constructed to date (described in Section 1.2.1). The action area is encompassed by levees built from around 1850 up through 1960. Several large-scale bank repair actions have occurred within the action area prior to this consultation. The largest are by far the Sacramento River Bank Protection Program (SRBPP) and the West Sacramento General Re-evaluation Study (West Sac GRS), a sister project to the ARCF proposed action.

The SRBPP was originally authorized by the Flood Control Act of 1960, in order to protect levees and flood control facilities of the SRFCP from erosion damage. The SRBPP has been thus far described in two phases: SRBPP Phase I and Phase II. Each phase includes flood risk management actions consisting mainly of bank protection and levee repairs to correct erosion problems and protect low-lying areas of the Sacramento Valley and Sacramento-San Joaquin Delta from damaging floods. Phase I was constructed from 1962 to 1975. Phase II was originally authorized in 1974 and consists of 405,000 LF of bank protection. An additional 80,000 LF was added to Phase II by the Water Resources Development Act (WRDA) of 2007, and 30,000 LF of this has been consulted on previously with NMFS.

The West Sac GRS was consulted on in 2015 and has not yet been constructed. Based on information provided by the USACE, it is likely that construction will begin concurrently with the ARCF proposed action. The West Sac GRS will be constructing erosion repairs on the west side of the Sacramento River from the Sacramento Bypass, stretching down 11 miles as well as installing cut-off walls and further repairs within the Deep Water Ship Channel and levees within the Yolo Bypass. The construction will require the removal of most of the riparian vegetation from the levee temporarily, with up to 66% permanent vegetation loss possible. The construction was mitigated for locally through the Southport levee setback, a large floodplain construction action that was completed in 2018. This provided access to 120 acres of historic floodplain habitat to offset the impacts of the construction of the West Sac GRS action.

Although site-level impacts have been addressed from compensatory mitigation associated with the SRBPP and West Sac GRS, ecosystem impacts have largely been left unaddressed. Levees constructed as part of the SRBPP have replaced the naturally occurring shallow water habitat that existed along the banks of rivers and sloughs, which historically provided a spectrum of complex habitats. Shallow water habitats had a broad range of depths, water velocities, riparian vegetation, fallen trees and instream woody materials (IWM), and gave the river the ability to migrate across the floodplain to create additional complexity in the geometry of its cross section. Naturally flowing rivers were able to construct riverside benches and naturally formed levees during flood events. These benches could be up to 20 feet high and extended for considerable distances inland, creating suitable conditions for the establishment and successful development of structurally diverse riparian vegetation communities (The Bay Institute 1998). Large, continuous corridors of riparian forests and vegetation were present along major and minor rivers and streams in the Central Valley. Native fish species, including listed salmonids and green sturgeon, evolved under these environmental conditions.

The construction of levees and the "reclamation" of floodplains eliminated these riparian areas. Only remnant riparian forests exist in the action area today, as many of the levees are extensively riprapped with stone armoring. Only in a few areas where waterside benches exist outside of the levee toe and vegetation is allowed to grow, does naturally established vegetation exist. These stands of riparian vegetation are discontinuous and frequently very narrow in width, providing a fraction of the ecological benefits of their historical predecessors.

In particular, the loss of large wood recruitment and IWM on a large-scale is becoming increasingly concerning, as our understanding of the functionality of IWM for fish and other wildlife resources continues to develop. IWM is very important to fish, playing key roles in physical habitat formation, sediment and organic-matter storage, and in maintaining essential habitat complexity and refugia (USFWS 2004). Loss of IWM reduces habitat quality and carrying capacity (USFWS 2004). The act of riprapping river banks not only removes any existing IWM, but prevents recruitment of IWM along the riprapped banks and reduces the retention of IWM recruited from any upstream, non-armored areas (USFWS 2004). In fact, "the cumulative loss of IWM functioning for the lower Sacramento River is now likely at least 67-90%, or more, compared to pre-SRBPP conditions" (USFWS 2004).

Loss of IWM negatively impacts salmonids through multiple phases of their life history. Schaffter et al. (1983) showed that juvenile Chinook salmon densities along riprapped banks are one third that of natural banks with the presence of fallen trees and their root balls in the water. They concluded that traditional riprap methods of protection will likely cause decreases in the salmon numbers in the Sacramento River basin. USFWS (2000) reported that in studies conducted in the Sacramento River near the Butte Basin, the highest number of juvenile Chinook salmon were associated with the nearshore areas with woody material, sloping banks, and moderate velocities. Juvenile Chinook salmon catches (i.e., measured as catch per unit effort) were consistently lowest at riprapped sites and highest at natural bank sites with overhead cover and IWM, and intermediate in areas where experimental mitigation studies with artificially placed IWM. USFWS (2000) reported that additional studies conducted between Chico Landing and Red Bluff on the Sacramento River confirmed the low value of riprapped banks, the high value of natural banks with varying degrees of instream and overhead woody cover, and the intermediate value of mitigated sites.

In large mainstem streams and rivers such as the Sacramento River, the primary benefit of IWM occurs along channel margins. The woody materials act to deflect and break up stream flow, creating small eddies, pools, undercut banks, variability in channel depth, and back water areas conducive to rearing and growth (Murphy and Meehan 1991, Bisson et al. 1987). Sediment that is trapped by the woody material and stored along the channel margins contributes to the hydraulic and biologic complexity of the stream reach, particularly where organically rich materials are present (Bisson et al. 1987). These storage areas create new habitat complexity by trapping inorganic material that creates bars and holes and organic materials that contribute energy and carbon to the local food web of the stream reach (Murphy and Meehan 1991, Bisson et al. 1987). These breaks in the river flow also create ideal holding areas with plentiful food resources and the conditions where salmonids can hold with minimal energy expenditure and feed while rearing. These areas are also beneficial to a wide range of other species native to the system. Such refuges are critically important to the lower river reaches where levee construction and riprapping have disconnected the rivers from the adjoining floodplain where slow water refugia and rearing habitats formerly existed.

Riprapping affects the stability of IWM along the river channel margin. Stable wood retention is important for creating and maintaining good fish habitat (Bisson et al. 1987). Whole trees and their root balls are more important for long-term stability than smaller fragments, as they tend to stay in place for long periods of time. These large pieces of wood may remain in place for decades and in the process trap additional IWM, thus adding complexity to the overall bank structure. The longevity of IWM, however, may mask changes in the input of woody materials to the river. Since these large pieces of wood would normally be slow to decay, a decline in the woody material input may be masked. Riprapping of the upper river and Delta waterway banks prevents the normal input of upstream woody materials through erosion. The homogeneity and unvarying hydraulic roughness along the riprapped banks prevent pieces of woody materials from becoming anchored and remaining in place. The woody materials are transported downstream, but the riprapping of the lower river and Delta waterway banks further limit these pieces from becoming lodged on the banks and the woody material is lost to the system. There is a continuing reduction of IWM input from upstream and local waterways, so much so, that the presence of IWM in the Delta is becoming exceedingly rare. SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon must all migrate through the Delta in order to survive, and therefore the large-scale removal of IWM upstream affects listed species growth and survival. Existing pieces that are removed or break apart from decay are not being replenished from upstream.

Riprapping halts the accretion of point bars and other depositions where new riparian vegetation can colonize (DWR 1994 cited in USFWS 2004). Riprapping also halts the meander migration and reworking of floodplains, which eventually reduces habitat renewal, diversity, complexity, and heterogeneity (DWR 1994; Larson 2002; USFWS 2004). This, in turn, has adverse effects on aquatic ecosystems, ranging from carbon cycling to altering salmonid population structures and fish assemblages (Schmetterling 2001; USFWS 2004). Riprapping can also incise the thalweg of the river adjacent to the riprapped area, narrowing the low-flow channel width, resulting in decreased hydrological and biological diversity (DWR 1994, USFWS 2004). Riprapping decreases river sinuosity, which increases the river channel slope, increasing the bedload transport and possible bed degradation and scour near the toe of the riprapped bank

(USFWS 2004, Larson 2002). Riprapping alters the future channel planform of the river at the riprapped site as well as downstream from the site, which can cause more erosion of the channel bank downstream than if the riprap revetment were not present (USFWS 2004, Larson 2002).

Riprapping creates a relatively smooth surface along the riverbank, which is contrary to the habitat hydrodynamic complexity required for endangered salmonids (Lister 1995; NRC 1996; USFWS 2004). Riprap fills in sloughs, tributary channels, and oxbow lake areas, causing loss of nearby wetland habitat and diversity (USFWS 2004, DWR 1994). Riprap limits the lateral mobility of the river channel, decreasing general habitat complexity in the near-shore aquatic area and reducing complex lateral habitat, including small backwaters and eddies, which removes important refugia for plants, invertebrates, fish, birds, and mammals (USFWS 2004; Welcomme 1979). Riprapping also decreases near-shore roughness, which causes stream velocities to increase more rapidly with increasing discharge, further eliminating critical refugia areas for fish and other aquatic organisms during high flows and causing accelerated erosion downstream, which can in turn result in riprap creating the need for more riprap (Gregory 1991; USFWS 2004). Riprap also halts erosion and reduces habitat complexity, which in turn reduces the ability of near-shore areas to retain sediments and organic materials, and isolates the river from its watershed (Gregory 1991; USFWS 2004). Riprap impedes plant growth, resulting in vegetation being pushed far back from the shoreline, further reducing food resources for aquatic invertebrates that would have been provided from such vegetation (Murphy 1991; USFWS 2004).

The above effects of riprapping are well documented, but there are additional, complex, and relatively poorly understood and unaddressed effects of large-scale riprapping, which warrant additional study and consideration (USFWS 2004). Studies that seek to provide insights into presently poor understood effects of large-scale riprapping include those related to the effects of bank stabilization of channelization on rivers, and the effects of snagging and clearing operations (USFWS 2004).

*Environmental Effects of the USACE Vegetation Policy*

The continuation of the USACE Engineering Technical Letter (ETL) policy of no vegetation within 15 feet of the levee toe on both the waterside and landside of the levee greatly exacerbates the negative attributes of the currently armored levee habitat in the area. Removal of the vegetation on the waterside and landside of the levees prevents the input of allochthonous organic materials to adjacent waterways and severely reduces the function of riparian and nearshore habitat along the affected levee reaches. By preventing the input of organic materials that serves as a source of energy and organic carbon, aquatic and terrestrial food webs are negatively impacted and the quantity and quality of nearshore rearing habitat is measurably reduced. Removal of riparian vegetation has reduced the amount of overhead shade along significant stretches of the Sacramento River mainstem and tributaries.

Compliance with the ETL policies prevents the establishment of riparian vegetation communities. The ETL policy does not allow woody vegetation to become established that could eventually be recruited into the adjacent aquatic habitat through erosion or death of the woody plants. Allowance of only grasses, sedges, and small bushes to grow on the waterside banks of the levees will not create the full functionality of a riparian zone, or create the equivalent complexity of habitat that a full riparian vegetation community would possess.

The NMFS Salmonid Recovery Plan identifies loss of juvenile rearing habitat in the form of lost natural river morphology and function, and lost riparian habitat and instream cover as a "very high stressor" affecting the viability of salmon and steelhead in the Central Valley (NMFS 2014). The Recovery Plan also establishes a strategic approach to recovery, which identifies critical recovery actions for the Central Valley, as well as watershed- and site-specific recovery actions. Watershed-specific recovery actions address threats occurring in each of the rivers or creeks that currently support spawning populations of SR winter-run Chinook salmon ESU, the CV spring-run Chinook salmon ESU, or the CCV steelhead DPS. Site-specific recovery actions address threats to these species occurring within a migration corridor (e.g., Sacramento River [SAR], San Francisco Bay, or the Delta [Del], Feather River [FER], American River [AMR]). Relevant recovery actions proposed include:

CEV-1.8 (Priority 1): *Develop and implement State and National levee vegetation policies to maintain and restore riparian corridors.*

Del-1.4 (Priority 1): *Conduct landscape-scale restoration of ecological functions throughout the Delta to support native species and increase long-term overall ecosystem health and resilience.*

Del-1.7 (Priority 1): *Restore, improve and maintain salmonid rearing and migratory habitats in the Delta and Yolo Bypass to improve juvenile salmonid survival and promote population diversity.*

SAR-1.2 (Priority 1): *Restore and maintain riparian and floodplain ecosystems along both banks of the Sacramento River to provide a diversity of habitat types including riparian forest, gravel bars and bare cut banks, shade vegetated banks, side channels, and sheltered wetlands, such as sloughs and oxbow lakes following the guidance of the Sacramento River Conservation Area Handbook (Resources Agency of the State of California 2003).*

SAR-2.1 (Priority 2): *Ensure that riverbank stabilization projects along the Sacramento River utilize bio-technical techniques that restore riparian habitat, rather than solely using the conventional technique of adding riprap.*

SAR-2.8 (Priority 2): *Implement projects that promote native riparian (e.g., willows) species including eradication projects for non-native species (e.g., Arundo, tamarisk).*

SAR-2.11 (Priority 2): *Improve instream refuge cover in the Sacramento River for salmonids to minimize predatory opportunities for striped bass and other non-native predators.*

AMR-1.6 (Priority 1): *Implement a long-term wood management program to provide habitat complexity and predator refuge habitat.*

AMR-2.5 (Priority 2): *Develop and implement programs and projects that focus on retaining, restoring and creating river riparian corridors within their jurisdiction in the American River Watershed.*

AMR-2.7 (Priority 2): *Utilize bio-technical techniques that integrate riparian restoration for riverbank stabilization instead of conventional riprap in the American River.*

ETL compliance that reduces or eliminates the potential for establishing riparian communities along the program's levee reaches will significantly impair implementation of these key recovery actions and will make it difficult to recover the ecosystems upon which ESA-listed salmon and steelhead in the Central Valley depend. Furthermore, the ongoing requirement under the ETL to remove vegetation will typically require the application of herbicides to control vegetation on the levee faces. Herbicides and their additives, such as surfactants, can have negative or deleterious effects upon sensitive receptors of fishes, invertebrates, or plants, in the aquatic environment. Spraying of herbicides on "unwanted" vegetation can create situations where the herbicides drift into adjacent waters and contaminate those water bodies, or is contained in runoff from surface flow during rain events.

Future projects should focus on channel margin enhancement to protect and restore key migratory and rearing areas. Degradation of channel margins by retaining riprap and removing riparian and nearshore vegetation should be mitigated on-site first or at least elsewhere on the migratory corridor. Benefits from off-site mitigation should be carefully evaluated, as the species impacted from the program development may not benefit at all from mitigation conducted elsewhere, particularly if the mitigated area is removed from the migratory corridors of the impacted fish populations (i.e., the ESUs and DPSs of listed fish species).

The reduction in the quality and quantity of beneficial habitat through previous actions, and the continued maintenance of these poorly functioning habitats through discretionary actions of vegetation management results in the severely diminished habitat value for ESA-listed fish species.

### 2.4.2. Status and Recovery Needs for Species in the Action Area

The action area, which is described above, encompasses the mainstem and tributaries of the Sacramento River, from RM 45 to the Sacramento Weir and Bypass (RM 63), the lower 12 miles of the American River, and all associated floodplains and riparian areas at and adjacent to the proposed construction sites. These sites function as a migratory corridor for SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. The action area is also used for rearing and adult feeding.

#### Presence of SR winter-run Chinook salmon in the Action Area

The temporal occurrence of SR winter-run Chinook salmon smolts and juveniles within the action area are best described by a combination of the salvage records of the CVP and SWP fish collection facilities and the fish monitoring programs conducted in the northern and central Delta. Based on salvage records at the CVP and SWP fish collection facilities, juvenile SR winter-run Chinook salmon are expected in the action area starting in December. Their presence peaks in March and then rapidly declines from April through June. The majority of SR winter-run juveniles will enter the action area during February through June. Presence of adult Chinook salmon is interpolated from historical data. While no spawning population of SR winter-run exists within the American River, rearing juveniles have been captured at the screw traps at RM 9, and expected to be present within the Lower American River in similar time windows as their presence in the Sacramento River. Adult SR winter-run Chinook salmon are expected to enter the action area starting in January, with the majority of adults passing through the action area between February and April.

The action area contains CV SR winter-run Chinook salmon from the Basalt and Porous Lava Diversity group (i.e., mainstem Sacramento River below Keswick Dam). Within the action area, there are “Core 1” populations of SR winter-run Chinook salmon, as designated in the Recovery Plan for the species (NMFS 2014). Core 1 watersheds possess the known ability or potential to support a viable population. For a population to be considered viable, it must meet the criteria for low extinction risk for Central Valley salmonids (Lindley et al. 2007). The criteria include population size, population decline, catastrophic decline and hatchery influence.

**Presence of CV spring-run Chinook salmon in the Action Area**

CVP/SWP salvage records and the northern and Central Delta fish monitoring data indicate that juvenile CV spring-run Chinook salmon first begin to appear in the action area in December and January, but that a significant presence does not occur until March and peaks in April. By May, the salvage of juvenile CV spring-run Chinook salmon declines sharply and essentially ends by the end of June. The data from the northern and central Delta fish monitoring programs indicate that a small proportion of the annual juvenile CV spring-run emigration occurs in January and is considered to be mainly composed of older yearling CV spring-run juveniles based on their size at date. Adult CV spring-run Chinook salmon are expected to start entering the action area in approximately January. Low levels of adult migration are expected through early March. The peak of adult CV spring-run Chinook salmon movement through the action area is expected to occur between April and June with adults continuing to enter the system through the summer. Currently, all known populations of CV CV spring-run Chinook salmon inhabit the Sacramento River watershed.

The action area contains CV spring-run Chinook salmon from the Basalt and Porous Lava Diversity group, Northwestern California Diversity group, and the Northern Sierra Nevada Diversity group. Within the action area, there are both “Core 1”, “Core 2”, and “Core 3” populations of CV spring-run Chinook salmon, as designated for by NMFS recovery plan for the species (NMFS 2014). The Core 1 populations include Battle Creek, Clear Creek, Butte Creek, Deer Creek, and Mill Creek. Core 2 populations meet, or have the potential to meet, the biological recovery standard for moderate risk of extinction. The Core 2 populations within the actions area include the Mainstem Sacramento (below Keswick), Cottonwood/Beegum Creek, Yuba River, Big Chico Creek, and Antelope Creek. These watersheds have lower potential to support viable populations, due to lower abundance, or amount and quality of habitat. These populations provide increased life history diversity to the ESU/DPS and are likely to provide a buffering effect against local catastrophic occurrences that could affect other nearby populations, especially in geographic areas where the number of Core 1 populations is lowest. Core 3 watersheds have populations that are present on an intermittent basis and require straying from other nearby populations for their existence. These populations within the action area are Thomes Creek and Stony Creek. These populations likely do not have the potential to meet the abundance criteria for moderate risk of extinction. Core 3 watersheds are important because, like Core 2 watersheds, they support populations that provide increased life history diversity to the ESU/DPS and are likely to buffer against local catastrophic occurrences that could affect other nearby populations. Dispersal connectivity between populations and genetic diversity may be enhanced by working to recover smaller Core 3 populations that serve as stepping stones for dispersal.

**Presence of CCV steelhead in the Action Area**

The CCV steelhead DPS final listing determination was published on January 5, 2006 (71 FR 834) and included all naturally spawned populations of steelhead (and their progeny) downstream of natural and manmade barriers in the Sacramento River and its tributaries. FRFH steelhead are also included in this designation. Depending on the year, there is potential spawning habitat present within the action area in the American River. There is also rearing and migration habitat present in the action area. Juveniles use rearing and migration habitat rear year-round in the mainstem Sacramento River and tributaries. Juveniles and smolts are most likely to be present in the action area during their outmigration, which begins in November, peaks in February and March, and ends in June.

Adult CCV steelhead originating in the Sacramento River watershed will have to migrate through the action area in order to reach their spawning grounds and to return to the ocean following spawning. Likewise, all CCV steelhead smolts originating in the Sacramento River watershed will also have to pass through the action area during their emigration to the ocean. The waterways in the action area also are expected to provide some rearing benefit to emigrating CCV steelhead smolts. The CCV steelhead DPS occurs in both the Sacramento River and the surrounding watersheds.

The action area contains CCV steelhead from the Basalt and Porous Lava Diversity group, Northwestern California Diversity group, and the Northern Sierra Nevada Diversity group. Within the action area, there are both “Core 1”, “Core 2”, and “Core 3” populations of CCV steelhead, as designated by NMFS Recovery Plan for the species (NMFS 2014). Core 1 populations include Battle Creek, Clear Creek, Deer Creek, Mill Creek, and Antelope Creek. Core 2 populations include Cow Creek, Mainstem Sacramento (below Keswick), Little Sacramento, Redding Area Tributaries, Putah Creek, Thomes Creek, Cottonwood/Beegum Creek, American River, Auburn Ravine, Feather River, Yuba River, Big Chico Creek, and Butte Creek. Core 3 populations are Stony Creek, Dry Creek, and Bear River.

**Presence of sDPS Green Sturgeon in the Action Area**

The Sacramento River is an important migratory corridor for larval and juvenile sturgeon during their downstream migration to the San Francisco Bay Delta and Estuary. Detailed information regarding historic and current abundance, distribution and seasonal occurrence of sDPS green sturgeon in the action area is limited due to a general dearth of sDPS green sturgeon monitoring. The action area is located on the main migratory route for adults moving upstream to spawn, post spawn adults migrating back to the ocean, juvenile outmigrants, and rearing subadults (NMFS, 2018). Juvenile sDPS green sturgeon are routinely collected at the CVP and SWP salvage facilities throughout the year. Based on the salvage records, sDPS green sturgeon may be present during any month of the year, and have been particularly prevalent during July and August. Adult sDPS green sturgeon begin to enter the Delta in late February and early March during the initiation of their upstream spawning run. The peak of adult entrance into the Delta appears to occur in late February through early April with fish arriving upstream in April and May. Adults continue to enter the Delta until early summer (June-July) as they move upriver to spawn. It is also possible that some adult sDPS green sturgeon will be moving back downstream in April and May through the action area, either as early post spawners or as unsuccessful spawners. Some adult sDPS green sturgeon have been observed to rapidly move back downstream following spawning, while others linger in the upper river until the following fall. It is possible that any of the adult or sub-adult sturgeon that inhabit the Delta may enter the American River.

### 2.4.3. Status of Critical Habitat within the Action Area

The Action Area encompasses areas along the Sacramento River from the Sacramento Bypass downstream to RM 45, the Yolo Bypass south the confluence of the Sacramento Bypass, the lower American River RM 11 downstream to the confluence with the Sacramento River, and other haul, access, and borrow sites associated with construction activities. Vessel traffic for construction material hauling may extend as far west as San Francisco in order to transport material to sites along the Sacramento River. Designated critical habitat for SR winter-run Chinook salmon (June 16, 1993, 58 FR 33212), CV spring-run Chinook salmon (September 2, 2005, 70 FR 52488), CCV steelhead (September 2, 2005, 70 FR 52488) and sDPS green sturgeon (October 9, 2009, 74 FR 52300) occur in the ARCF action area.

The PBFs of critical habitat essential to the conservation of SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead are physical habitat, water quality and quantity, available forage required to maintain habitat for spawning, larval and juvenile transport, rearing, and adult migration. PBFs for Chinook salmon and CCV steelhead within the action area include freshwater rearing habitat and freshwater migration corridors. The PBFs essential to the conservation of SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead include the following: sufficient water quantity and floodplain connectivity to form and maintain physical habitat conditions necessary for salmonid development and mobility, sufficient water quality, food and nutrients sources, natural cover and shelter, migration routes free from obstructions, no excessive predation, adequate forage, holding areas for juveniles and adults, and shallow water areas and wetlands. Habitat within the action area is primarily utilized for freshwater rearing and migration by CCV steelhead and Chinook salmon juveniles and smolts and for adult freshwater migration. CCV steelhead also utilize the parts of the American River within the action area for spawning habitat.

The PBFs essential to the conservation of sDPS green sturgeon are physical parameters needed for spawning, larval and juvenile transport, rearing, and adult migration. The action area includes the following sDPS green sturgeon PBFs: adequate food resources for all life stages; water flows sufficient to allow adults, subadults, and juveniles to orient to flows for migration and normal behavioral responses; water quality sufficient to allow normal physiological and behavioral responses; unobstructed migratory corridors for all life stages; a broad spectrum of water depths to satisfy the needs of the different life stages; and sediment with sufficiently low contaminant burdens to allow for normal physiological and behavioral responses to the environment.

The substantial degradation over time of several of the PBFs in the action area has diminished the function and condition of the freshwater rearing and migration habitats in the area. The action area now only has rudimentary functions compared to its historical status. The channels of the lower Sacramento and American Rivers have been replaced with coarse stone riprap on artificial levee banks and have been stabilized in place to enhance water conveyance through the system. The extensive riprapping and levee construction has precluded natural river channel migrations. The natural floodplains have essentially been eliminated, and the once extensive wetlands and riparian zones have been "reclaimed" and subsequently drained and cleared for agriculture.

Even though the habitat has been substantially altered and its quality diminished through years of human actions, its value remains high for the conservation of CV spring-run Chinook salmon, SR winter-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. Many of the factors affecting these species throughout their range are discussed in the Rangewide Status of the Species and Critical Habitat section of this opinion, and are considered the same in the action area. This section describes all factors that have resulted in the current state of critical habitats in the action area, particularly focusing on factors most relevant to the proposed action. During dry years, all out-migrating individuals from the Sacramento River and tributaries will travel through the action area, as this section is the bottleneck prior to opening into the Delta. During wet years, access to the Yolo Bypass allows fish to bypass the action area. The ARCF action area encompasses a very important portion of the remaining critical habitat for these species, and it is therefore critical to maintain the habitat functionality of what remains of the riparian corridors in the action area.

The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs affecting listed salmonids in the action area. Instream flows during the summer and early fall months have increased over historic levels for deliveries of municipal and agricultural water supplies. Overall, water management now reduces natural variability by creating more uniform flows year-round. Current flood control practices require peak flood discharges to be held back and released over a period of weeks to avoid overwhelming the flood control structures downstream of the reservoirs (i.e., levees and bypasses). Consequently, managed flows in the mainstem of the river often truncate the peak of the flood hydrograph and extend the reservoir releases over a protracted period. These actions reduce or eliminate the scouring flows necessary to mobilize gravel and clean sediment from the spawning reaches of the river channel.

High water temperatures also limit habitat availability for listed salmonids in the lower Sacramento River. High summer water temperatures in the lower Sacramento River can exceed 72°F (22.2°C), and create a thermal barrier to the migration of adult and juvenile salmonids (Kjelson 1982). In addition, water diversions for agricultural and municipal purposes have reduced in-river flows below the dams. These reduced flows frequently result in increased temperatures during the critical summer months which potentially limit the survival of holding/spawning adults, incubating eggs, emerging fry, and juvenile salmonids (Reynolds 1993). The elevated water temperatures compel many salmon juveniles to migrate out of the valley floor systems quickly and forgo adequate rearing time before summer heat creates temperatures unsuitable for salmonids. Those fish that remain either succumb to the elevated water temperatures or are crowded into river reaches with suitable environmental conditions.

Levee construction and bank protection have affected salmonid habitat availability and the processes that develop and maintain preferred habitat by reducing floodplain connectivity, changing riverbank substrate size, and decreasing riparian habitat and SRA cover. Individual bank protection segments of the overall proposed action typically range from a few hundred to a few thousand LF in length. Such bank protection generally results in two levels of impacts to the environment: (1) site-level impacts which affect the basic physical habitat structure at individual bank protection sites; and (2) reach-level impacts which are the cumulative impacts to ecosystem functions and processes that accrue from multiple bank protection sites within a given river reach. Revetted embankments result in loss of sinuosity and braiding and reduce the amount of aquatic habitat. Impacts at the reach level result primarily from halting erosion and eliminating riparian vegetation. Reach-level impacts which cause significant impacts to fishes are reductions in habitat complexity, changes to sediment and organic material storage and transport, reductions of primary food-chain production, and reduction in IWM and SRA habitat.

The use of rock armoring limits recruitment of IWM (i.e., from non-riprapped areas), and greatly reduces, if not eliminates, the retention of IWM once it enters the river channel. Riprapping creates a relatively homogeneous surface, which diminishes the ability of IWM to become securely snagged and anchored by sediment. IWM tends to become only temporarily snagged along riprap, and generally moves downstream with subsequent high flows. Habitat value and ecological functioning aspects are thus greatly reduced, because wood needs to remain in place to generate maximum values for fish and wildlife. Recruitment of IWM is limited to any eventual, long-term tree mortality and whatever abrasion and breakage may occur during high flows. Juvenile salmonids are likely being impacted by reductions, fragmentation, increased predation, and general lack of connectedness of remaining nearshore refuge areas.

Point and non-point sources of pollution resulting from agricultural discharge and urban and industrial development occur upstream of, and within the action area. The effects of these impacts are discussed in detail in the Rangewide Status of the Species and Critical Habitat section. Environmental stressors as a result of low water quality can lower reproductive success and may account for low productivity rates in fish (i.e., green sturgeon, (Klimley 2002)). Organic contaminants from agricultural drain water, urban and agricultural runoff from storm events, and high heavy metals concentrations may deleteriously affect early life-stage survival of fish in the Sacramento River (USFWS 1995). Principle sources of organic contamination in the Sacramento River are rice field discharges from Butte Slough, Reclamation District 108, Colusa Basin Drain, Sacramento Slough, and Jack Slough (USFWS 1995). Other impacts to adult migration present in the action area, including migration barriers, water conveyance factors, water quality, are discussed in the Rangewide Status of the Species and Critical Habitat section.

The transformation of the Sacramento River from a sinuous, meandering waterway lined with a dense riparian corridor, to a highly leveed system under varying degrees of control over riverine erosional processes has resulted in homogenization of the river. These impacts include the removal of valuable pools and holding habitat for sDPS green sturgeon. In addition, channelization and removal of riparian vegetation and IWM have greatly reduced access to floodplain and off-channel rearing habitat. It has also diminished the quantity and quality of benthic habitat and the abundance of prey items in rearing, foraging, and holding habitats. A major factor in the decline of sDPS green sturgeon, and the primary reason for listing this species was the alteration of its adult spawning and larval rearing habitat in California's Sacramento River Basin (71 FR 17757, April 7, 2006).

Rapid reductions in flow create isolation or stranding within the existing Sacramento Weir stilling basin and bypass during rapid reductions in flow. With normal flow scour, some areas can become isolated pools or even completely dewatered when flood flows reduce. Juveniles seek slower flow habitat as resting stops when the bypass is inundated, which can cause high numbers of strandings. Adults will also seek deeper pools to avoid rapidly reducing flows and be caught within deeper pools and scour holes. CDFW monitoring reports show a range of numbers of different species and runs of anadromous fish observed and rescued in these efforts (Email communication, Shig Kubo June 21, 2019). Stranding within the weir stilling basin and Sacramento Bypass have been documented to occur every 10 years or so, and was most previously documented in 2023.

### 2.4.4. Mitigation Banks and the Environmental Baseline

While USACE is proposing on-site and off-site mitigation to offset impacts from the proposed action, mitigation bank credits may be purchased to offset impacts. There is currently one conservation bank approved by NMFS with a service area that includes the action area considered in this opinion. This bank occurs within critical habitat for CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon.

***North Delta Fish Conservation Bank:*** Established in 2013, North Delta Fish Conservation Bank is an 811-acre site located in Yolo County and is approved by NMFS to provide credits for impacts to SR winter-run Chinook salmon, CV spring-run Chinook salmon and CCV steelhead. There are salmonid preservation and salmonid enhanced and created credits that are anticipated to be available prior to construction under the proposed action. All features of this bank are designated critical habitat for the species analyzed in this opinion.

## 2.5. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.02).

The Proposed Action includes activities that are likely to adversely affect SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, sDPS green sturgeon, and their associated critical habitats. The following is an analysis of the potential effects to the species and their critical habitat that are reasonably certain to occur as a result of the implementation of this project.

Of the 43,000 LF of proposed erosion protection work along the Sacramento River, up to 32 acres of SRA and benthic habitats are expected to be degraded within the Action Area by construction of rock revetment or placement of other materials associated with site-specific designs. This calculation is based on measurements from the river's OHWM down to the end of the repair area that is expected to be degraded by construction activities. Similarly, of the 31,000 LF within the construction footprint along the lower American River, up to 28 acres of SRA and benthic habitats are expected to be modified or altered by construction activities. These acreages were derived from applying a uniform assumption, based on best available information, that impacts would occur 100 to 200 feet from the OHWM down into the wetted channel to where the rock placement ends. As stated in the USACE 2020 BA, the OHWM elevation is based on an 18,500 cfs 2-year reoccurrence interval flow scenario (determined from the Folsom Dam Water Control Manual period of record analysis). While these assumptions were used to estimate the extent of habitat impacts, actual site designs may vary. The accounting plan will verify that tracking of impacts as site designs are developed to ensure the level of adverse effects does not extend beyond what is analyzed here.

Ancillary to erosion protection, site-specific designs will aim to avoid or minimize effects to federally listed species and designated critical habitat to the extent feasible, and will implement on-site and off-site compensation actions as necessary to offset the loss of vegetated habitat along the rivers. Depending on the effects from erosion protection measures, a site design may incorporate various features to compensate for the loss of habitat. The sites will be designed in coordination with the resource agencies (NMFS and USFWS), in a manner to ensure the USACE is minimizing effects to listed species and critical habitat and maximizing on-site mitigation for each site.

### 2.5.1. Effects to Listed Fish Species

The Lower American River portion of the Action Area is a National Wild and Scenic River, and managed by the National Park Service. In an effort to allow the National Park Service to separate the effects analysis within this opinion between watersheds, effects that will occur within the Lower American River will be indicated within each section. For the majority of the effects described below, they are similar between the species unless addressed in a more species-specific manner.

*Physical Disturbance*

Physical disturbance effects are expected within the entirety of the Action Area, including the Lower American River.

Physical disturbance in aquatic habitat will occur during construction activities, such as placement of materials (rock, soils, etc.), which have the potential to affect the juvenile and adult life stages of salmonids and green sturgeon through displacement, disruption of their normal behaviors, and direct injury or death from crushing during rock placement.

Instream construction activities may cause mortality and reduced abundance of benthic aquatic macroinvertebrates within the erosion footprint, due to the placement of rock over the existing streambed. These effects to aquatic macroinvertebrates are expected to be long-term as permanent bank armoring alters the natural streambed (USFWS 2004). The amount of food available for adult and juvenile salmonids and green sturgeon in the Action Area is therefore expected to be permanently decreased in the areas where submerged riprap is being placed.

During construction activities, both juvenile and adult fish may be able to detect areas of active disturbance and avoid those portions of the project footprint where equipment is actively operated or a turbidity plume occurs, particularly adults. Juveniles may also stay and hunker down in the activity zone. Occasionally, feeding juvenile salmonids and green sturgeon may be attracted to activity stirring up sediment, but are generally expected to avoid areas disturbed by active equipment. Juveniles will have opportunities to move to other portions of the channel where they can avoid potential injury or mortality. 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 or boulders are placed over them due to the disturbance caused by vibrations on land. Some level of injury and death from crushing by construction equipment and rock placement is expected due to the large scale of the project footprint, but will be reduced through avoidance and minimization measures.

Due to the large project footprint of this Proposed Action, it is expected that a small number of juveniles of each species will be injured or killed as a result of the physical disturbance and rock placement. Though adults are more likely able to avoid rock placement, a few adults will also likely be injured or killed due to the large scale of the Proposed Action.

Proposed O&M at the levees and Sacramento Weir will cause intermittent small-scale physical disturbance over the long-term. Small disturbances from levee O&M may cause localized behavioral disturbances resulting in temporary displacement. These are not expected to cause any injury or mortality to species.

*Increased Turbidity and Suspended Sediment*

Increased turbidity effects are expected within the entirety of the Action Area, including the Lower American River.

All activity within the Action Area with waterside repairs have the potential to temporarily increase turbidity and suspended sediment levels within the project work site and downstream areas. The re-suspension and deposition of instream sediments is an effect of construction equipment disturbances and rock entering the river. Increased exposure to elevated levels of suspended sediments have the potential to result in physiological and behavioral effects on fish.

The severity of these effects depends on the extent of the disturbance, duration of exposure, and sensitivity of the affected life stage.

Salmonids have been observed avoiding streams that are chronically turbid (Lloyd 1987) or moving laterally or downstream to avoid turbidity plumes (Sigler et al. 1984). Chronic exposure to high turbidity and suspended sediment may also affect growth and survival by impairing respiratory function, reducing tolerance to disease and contaminants, and causing physiological stress (Waters 1995). Less is known about the specific detrimental physical and physiological effects of sedimentation and turbidity to sturgeon. However, it is thought that high levels of turbidity can generally result in gill fouling, reduced temperature tolerance, reduced swimming capacity and reduced forage capacity in lotic fishes (Wood and Armitage 1997).

Elevated turbidity and suspended sediment levels have the potential to adversely affect salmonids during all freshwater life stages. Specifically, increased turbidity can clog or abrade gill surfaces, adhere to eggs, hamper fry emergence (Phillips and Campbell 1961), bury eggs or alevins, scour and fill in pools and riffles, reduce primary productivity and photosynthesis activity (Cordone and Kelley 1961), and affect intergravel permeability and dissolved oxygen levels (Lisle and Eads 1991; Zimmermann and Lapointe 2005).

Fish behavioral and physiological responses indicative of stress 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). Changes in turbidity and suspended sediment levels associated with water operations may negatively impact fish populations temporarily when deposition of fine sediments fills interstitial substrate spaces in food-producing riffles, reducing the abundance and availability of aquatic insects and cover for juvenile salmonids (Bjornn and Reiser 1991). Suspended solids and turbidity generally do not acutely affect aquatic organisms unless they reach extremely high levels (i.e., levels of suspended solids reaching 25 mg/L). At these high levels, suspended solids can adversely affect the physiology and behavior of aquatic organisms and may suppress photosynthetic activity at the base of food webs, affecting aquatic organisms either directly or indirectly (Alabaster and Lloyd 1980; Lloyd 1987; Waters 1995).

Increased turbidity can also affect fish by reducing feeding efficiency or success and stimulating behavioral changes. Sigler et al. (1984b) found that turbidities between 25 and 50 Nephelometric Turbidity Units (NTU) reduced growth of juvenile Coho salmon and steelhead, and Bisson and Bilby (1982) reported that juvenile Coho salmon avoid turbidities exceeding 70 NTUs. Turbidity likely affects Chinook salmon in much the same way it affects juvenile steelhead and Coho salmon because of similar physiological and life history requirements between the species. Newcombe and Jensen (1996) also found increases in turbidity could lead to reduced feeding rate and behavioral changes such as alarm reactions, displacement or abandonment of cover, and avoidance, which can lead to increased predation and reduced feeding. At high-suspended sediment concentrations for prolonged periods, lethal effects can occur. Juvenile salmonids are expected to be particularly susceptible to the effects of turbidity and predation.

Based on similar projects conducted by DWR and the USACE (i.e., levee repair work and placement of riprap), construction activities are expected to result in periodic increases in localized turbidity levels up to or exceeding 75 NTUs. In the past, levee protection work on the Sacramento River has produced turbidity plumes that travel for several hundred feet downstream of the activity. However, once construction stops, water quality is expected to return to background levels within a few hours, depending on how high the percentage of fines in the material are. Adherence to erosion control measures and avoidance and minimization measures will minimize the amount of disturbed sediment from construction activities and will minimize the potential for post-construction turbidity changes should precipitation events occur after construction has been completed.

Generally, we expect that most fish will actively avoid the elevated turbidity plumes when possible, during construction activity. For those fish that do not or cannot avoid the turbid water, exposure is expected to be brief (i.e., minutes to hours) and is not likely to cause injury or death from reduced growth or physiological stress. This expectation is based on the general avoidance behaviors of salmonids and the proposal to suspend construction when turbidity exceeds Central Valley Regional Water Quality Control Board standards (2020 USACE BA). Proposed O&M at the levees and Sacramento Weir will also cause intermittent small-scale increases in turbidity over the lifetime of the proposed action. Small increases in turbidity are expected to result in minor, brief localized behavioral disturbances, and not expected to cause any injury or mortality to species.

However, some juveniles that are exposed to turbidity plumes may be injured or killed by predatory fish that take advantage of disrupted normal behavior. Once fish move past the turbid water, normal feeding and migration behaviors are expected to resume. A low proportion of fish that are exposed to the area of increased turbidity are expected to be adversely affected by increased predation resulting in injury or death due to displacement and the lowered visibility caused by the suspended sediment.

*Acoustic Impacts during Construction Activities*

Acoustic effects are expected within the entirety of the Action Area, including the Lower American River.

Noise, motion, and vibrations produced by heavy equipment operation are expected at each site. The use of heavy equipment will occur outside the active channel, in addition to the infrequent, short-term use of heavy equipment in the wetted channel. Most listed fishes will be expected to move away and avoid interaction with instream machinery by temporarily relocating either upstream or downstream into suitable habitat adjacent to the worksite. As a result, we anticipate minimal localized effects to listed fishes from instream machinery acoustic impacts. Due to the large span of the project, the aggregated acoustic effects are expected to have adverse effects to a moderate proportion of fish in the area such that these effects may result in injury or death to a small number of listed fish.

The excavation and placement of rock below the waterline will produce noise and physical disturbance, which could displace juvenile and adult fish into adjacent habitats. Similarly, construction activities carried out in close proximity to the river channel have the potential to transfer kinetic energy through the adjoining substrates, disturb the water column, and cause behavioral changes to fish in the nearby area, resulting in increased predation and decreased feeding. These effects are expected to occur during construction activities and to cease once rock placement is completed.

Multiple studies have shown responses in the form of behavioral changes in fish due to human produced noise (Wardle et al. 2001, Slotte et al. 2004, Popper and Hastings 2009). Instantaneous behavioral responses may range from slight variations, a mild awareness, to a startle response. Fish may also vacate their normally occupied positions in their habitat for short or long durations. Depending on the behavior that is being disrupted, the short- and long-term negative effects could vary. Behavioral effects are likely to affect juvenile fish more than adults, as there are essential behaviors to their maturation and survival, such as feeding and sheltering, as adults generally use the action area only for migration and potentially spawning. Overall, construction could disrupt behavior in some instances, which may result in behavioral response leading to injury or death, but because the proposed timing of activities resulting in underwater noise disturbances would be high when the fewest fish and least sensitive life stages are present, effects would be minimal. Proposed operations and maintenance will cause intermittent small-scale increases in noise over the lifetime of the proposed action, but will also occur during windows where fish are unlikely to be present.

*Acoustic Impacts during Pile-Driving Activities*

Pile-driving activities and associated effects are expected within the entirety of the Action Area, including the Lower American River.

Pile driving will occur both within the channel for cofferdam installation, and outside the channel for construction and monitoring efforts. Large posts will need to be driven to support walls of cofferdams, attach monitoring equipment to, and as supports for the Sacramento Weir. Piles that are driven into riverbed substrate propagate sound through the water, which can damage a fish's swim bladder and other organs by causing sudden rapid changes in pressure, rupturing or hemorrhaging tissue in the bladder (Gisiner 1998, Popper et al. 2006). The swim bladder is the primary physiological mechanism that controls a fish's buoyancy. A perforated or hemorrhaged swim bladder has the potential to compromise the ability of a fish to orient itself both horizontally and vertically in the water column. This can result in diminished ability to feed, migrate, and avoid predators. Sensory cells and other internal organ tissue may also be damaged by noise generated during pile driving activities as sound reverberates through a fish's viscera (Gaspin 1975). In addition, morphological changes to the form and structure of auditory organs (saccular and lagenar maculae) have been observed after intense noise exposure (Hastings et al.1996). It is important to note that acute injury resulting from acoustic impacts should be scaled based on the mass of a given fish. Juveniles and fry have less inertial resistance to a passing sound wave and are therefore more at risk for non-auditory tissue damage (Popper and Hastings 2009). Fish can also be injured or killed when exposed to lower sound pressure levels for longer periods of time. Hastings (1996) found death rates of 50% and 56% for gouramis (*Trichogaster* sp.) when exposed to continuous sounds at 192 decibel (Db) (re 1 µPa) at 400 Hz and 198 dB (re 1 µPa) at 150 Hz, respectively, and 25% for goldfish (*Carassius auratus*) when exposed to sounds of 204 dB (re 1 μPa) at 250 Hz for 2 hours or less. Hastings (1995) also reported that acoustic "stunning," a potentially lethal effect resulting in a physiological shutdown of body functions, immobilized gourami within 8 to 30 minutes of exposure to the aforementioned sounds. While the effects to salmonids and sturgeon may not be identical, it is assumed that these effects would be similar for salmonids and sturgeon.

USACE proposes to implement Interim Criteria for Injury of Fish Exposed to Pile Driving Operations (Popper 2006). These criteria use a combined interim single strike criterion for pile driving received level exposure; a sound exposure level (SEL) of 187 dB re: 1 $\mu Pa^2$•sec and a peak sound pressure of 208 dB re: 1 μPapeak as measured 10 m from the source. Using these criteria is expected to reduce the potential for permanent and lethal impacts to fish that are within the area and may be exposed to pile driving activities. Fish that are exposed to the area where pile driving is occurring are expected to be adversely affected by behavioral modification during increases in noise and vibration within the water column, including relocation/displacement. While this will be a short-term effect for most fish, some injury or mortality is expected to occur due to the use of pile driving over 5 or more construction seasons, and over such a large span of habitat. While pile-driving noise is expected to cause localized behavioral disturbances to a moderate number of fish, injury or lethal effects are expected to occur to only a few juvenile fish (of each species) each year for the course of project implementation.

*Cofferdam Installation and Dewatering*

Cofferdam installation and dewatering activities and associated effects are expected within the entirety of the Action Area, including the Lower American River.

Installation of cofferdams may be necessary during construction of a small proportion of sites, though the exact number is uncertain because full designs are not completed for all sites. We assume no more than 50 percent of sites would need to use cofferdams, based on the information provided. Sites that may require cofferdams are generally sites that have soil being placed at low water areas to keep a more natural bank line or install a planting bench (as it is very difficult to place soil underwater). Cofferdams will be installed during the proposed work windows when fish will be less prevalent and would be in place for a single construction season. Cofferdams will remain closed during construction, eliminating the ability for fish to re-enter the area. Cofferdams will be either constructed of sand bags (placed by hand), or sheet pile (requiring pile driving, effects of which are described above), depending on the level of dewatering needed for construction.

Dewatering activities within the cofferdam areas would cause adverse effects to any fish isolated within the area. The amount of fish trapped within the area initially would be minimized with BMPs, but there is still the chance of a few juvenile fish being entrained within the cofferdam area. Dewatering activities pose the risk of increased turbidity, stress, desiccation, and possible impingement from pumping activity. Capture/relocation efforts are described below.

Fish that evade capture and remain within the cofferdam in the construction area would likely be injured or killed from construction activities. This includes desiccation if fish remain in the dewatered area or death if fish are crushed by personnel or equipment. However, because experienced biologists will be collecting fish, most are expected to be removed from the area before construction. While BMPs will reduce effects, injury and mortality of a few fish within each cofferdam are expected over the entirety of construction due to the large scale of this project over several years of construction.

*Fish Capture and Relocation Effects*

Fish capture and relocation activities and associated effects are expected within the entirety of the Action Area, including the Lower American River

Fish relocation may need to occur during implementation of the Proposed Action. Relocation will be needed during activities that require a cofferdam, and during rescue efforts within the Sacramento Weir. For cofferdam installation, fish will first be gently "herded" out of the area before any direct handling occurs. If fish cannot be herded, they will be collected using seining or dip netting. Any adults present are expected to move out of the area of activity and avoid capture. Juveniles are more likely to be entrained or isolated in the coffer dammed work areas and any that avoid herding, would require capture and relocation prior to dewatering and construction activities. Cofferdams will be constructed immediately after fish are "herded" out of the area, with netting continuing to occur as the area is dewatered.

Fish relocation activities pose a risk of injury or mortality since any fish relocation or collection gear has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of unintentional injury and mortality attributable to fish relocation varies widely depending on the method used, ambient conditions, and the experience of the field crew. Elevated air and water temperatures during handling may cause added fish stress and increased mortality. Potential sub-lethal temperature effects on juvenile salmonids include slowed growth, delayed smoltification, desmoltification, and extreme physiological changes, which can lead to disease and increased predation (Myrick and Cech 2004). Since fish relocation activities will be conducted by qualified fisheries biologists following NMFS guidelines, injury and death is expected to be minimized. As multiple relocations may need to occur each year throughout implementation of the Proposed Action, a small proportion of juvenile fish injury and mortality is expected to occur at each work site that requires relocation. Currently relocation efforts are expected at 1 to 2 sites on the Sacramento River, the Arden Pond site on the American River, and at the location for the new Sacramento Weir. Proposed operations and maintenance may require intermittent fish rescues over the lifetime of the proposed action. For example, if there is a debris blockage within the fishway, fish may need to be captured and relocated if the debris cannot be quickly removed to restore passage. Based on past occurrences, we expect a small number fish to be injured or killed during relocation efforts depending on the size of the stranding areas in intermittent years when those efforts occur.

*Impingement*

Impingement effects resulting from pumping activities are expected within the entirety of the Action Area, including the Lower American River.

Pumping activities are being proposed both for dewatering activities and for irrigation purposes during the Proposed Action construction and long-term maintenance and monitoring. Impingement is expected to occur when the approach velocity of a fish screen exceeds the swimming capability of a fish, creating substantial body contact with the surface of a fish screen.

Injury resulting from impingement may be minor and create no long-term harm to the fish, or result in injuries leading to mortality either immediately or at some time in the future after contact with the screen, including predation or infections from wounds and abrasions associated with the screen contact.

NMFS' screening criteria (NMFS 2023) will be followed for all pumping activities of the Proposed Action. The NMFS' criteria are such that they will reduce exposure time of fish to a screen and, therefore, the potential for impingement as fish move past it. Other aspects of the criteria include appropriate screen mesh sizing to prevent entrainment of juvenile salmonids. The efficacy of the screening criteria is untested on juvenile green sturgeon, however. As pumping activities will only be occurring in the action area which is on the downsteam area of the river system, larval green sturgeon are unlikely to be present and therefore exposure to pumping that will risk impingement or entrainment is extremely unlikely.

As the pumping activities will adhere to NMFS screening guidelines, injury to fish caused by impingement will be minimized. However, pumping activities may occur for several years during construction across large spans of the action area. A small portion of fish exposed to the pumping activities (small numbers) are expected to be injured or killed each year from impingement. Pumping activities will only occur during the initial planting period and are not proposed beyond the first 5 years of planting.

*Stranding*

Stranding effects are expected to occur within the Sacramento Weir and Bypass, and at Contract 4A on the Lower American River.

Rapid reductions in flow can adversely affect fish. Juvenile salmonids are particularly susceptible to isolation or stranding during rapid reductions in flow. Isolation can occur when the rate of reductions in stream flow inhibits an individual's ability to escape an area that becomes isolated from the main channel or dewatered (U.S. Fish and Wildlife Service 2006). The effect of juvenile isolation on production of Chinook salmon and steelhead populations is not well understood, but isolation is frequently identified as a potentially important mortality factor for the populations in the Sacramento River and its tributaries (Jarrett and Killam 2014; National Marine Fisheries Service 2009; U.S. Bureau of Reclamation 2008; U.S. Fish and Wildlife Service 2001; Water Forum 2005).

Juveniles typically rest in shallow, slow-moving water between feeding forays into swifter water. These shallower, low-velocity margin areas are more likely than other areas to dewater and become isolated with flow changes (Jarrett and Killam 2015). Accordingly, juveniles are most vulnerable to isolation during periods of high and fluctuating flow when they typically move into inundated side channel habitats. Isolation can lead to direct mortality when these areas drain or dry up or to indirect mortality from predators or rising water temperatures and deteriorating water quality.

Isolation is currently a potential stressor in the Sacramento Bypass. Juveniles seek slower flow habitat as resting stops when the bypass is inundated by higher flows. With normal flow scour, some areas can become isolated pools or even completely dewatered when flood flows reduce. CDFW monitoring reports show a range of numbers of different species and runs of anadromous fish observed and rescued in these efforts (Shig Kubo 2019). The dependence of isolation risk on factors, such as rate of snowmelt and timing and rate of flood flows makes the quantification of stranding risk difficult. While stranding risk may be increased with the expansion of the Sacramento Weir and Bypass, the proposed fish passage facility is expected to increase the amount of adults able to return to the Sacramento River, and juveniles able to reach the Tule Canal.

As the new stilling basin is designed to drain fully, no stranding is expected to occur within it. However, stranding is possible within the less hardened areas of the new bypass and fish transport channel where some scour and elevation change may occur over time. Sacramento Weir O&M procedures include regular inspections and maintenance to identify and resolve potential stranding locations. Rescues will be performed by the USACE or DWR as often as conditions allow. Conditions that may not allow rescues include elevated flows or rain events that would make it dangerous for personnel to enter the bypass. Cases of stranding adults and juveniles of all species are still likely to occur for the life of this project structure due to the natural process of erosion and creation of deeper pools within the bypass.

The design of the fish passage facility is expected to minimize potential stranding risk within the bypass and allow a longer period of time for adults to make their way back into the mainstem river. The proposed changes to the existing Sacramento Weir stilling basin is expected to greatly reduce juvenile stranding within the current weir's stilling basin. While the expansion of the bypass and weir may cause increased stranding risk, it is expected that the other aspects of the weir's design and O&M activities will reduce impacts and minimize overall stranding within the bypass and stilling basin. Despite the expected fish passage improvements, a small number of juvenile and adult fish are still expected to be stranded, resulting in injury or death, related to the existence of the Sacramento Weir and associated levee systems surrounding the Sacramento Bypass.

Work associated with Contract 4A on the Lower American River includes the construction of a berm for the realigned Jedediah Smith Memorial Trail. The berm will result in the disconnection of a 5-acre area of an existing floodplain at periodic higher flow (AEP 1/9) above elevation at 28 NAVD88-ft. The entire existing floodplain area is known to potentially strand fish (Sacramento County Parks 2023). In order to address the existing drainage and stranding issue in this area it would be necessary to address both the elevation issues in the stormwater channel on the north of the site, and the floodplain depression at the center of the site. As it exists, there are numerous fish passage barriers such as debris and undercut culverts within the stormwater channel which prevent fish from returning to the American River. The American River Parkway Natural Resources Management Plan (Sacramento County 2023) identifies the need to address fish stranding, including this location. It is likely that stranding and passage within this floodplain area will be addressed holistically through a County restoration project in the future.

Construction of the berm is likely to reduce fish stranding during overtopping in the floodplain between elevation 28 NAVD88-ft, as it will separate the stormwater channel from the greater floodplain area. As flows recede, fish would be more likely to exit the floodplain area to the American River rather than the stormwater channel. While some fish may be stranded in the 5-acre area when elevations exceed 28 NAVD88-ft, it does not create a new stranding risk on this floodplain. It is expected that the construction of the berm will reduce stranding overall in the floodplain area. Continued stranding of a small number of juveniles is expected approximately every ten years, when the area is flooded, resulting in mortality of a small number of juvenile salmonids.

*Chemical Contamination*

Chemical contamination effects could occur within the entirety of the Action Area, including the Lower American River.

Equipment refueling, fluid leakage, concrete pouring, and maintenance activities within and near the stream channel pose some risk of contamination and potential impacts to listed fish species. Concrete work will be performed during certain aspects of the Project. Contact with uncured concrete may cause significant increase in the pH of the surrounding waters, negatively affecting aquatic life. Lime is a major component of cement and concrete work. It easily dissolves in water and drastically changes the pH of water increasing the alkalinity (pH 11-13), which causes burns on fish and kills other aquatic life. Project activities that cause concrete to contact water include raw concrete spills, disposal of concrete, dampening freshly laid concrete, and washing equipment. However, all projects will include the minimization measures outlined above in Section 1.3.15 Fisheries Conservation Measures, which address and minimize pollution risk from equipment operation. Therefore, water quality degradation from toxic chemicals associated with the rehabilitation projects is expected to be improbable. Chemical contamination effects could occur within the entirety of the Action Area, but is improbable and not expected to occur.

*Increased Vessel Traffic in the Action Area*

Effects resulting from construction-related increased vessel traffic are expected within the Sacramento River portions of the Action Area, but not within the Lower American River.

The proposed action would significantly increase vessel traffic during times where riprap is being transported to the construction sites. The impacts from construction-related vessel traffic may lead to mortality or may induce changes in behavior that impair feeding, rearing, migration, and/or predator avoidance. The Proposed Action requires barge usage to transport riprap from as far away as the San Francisco Bay up to and throughout the Action Area on the Sacramento River. The increase in barge traffic to the multiple erosion protection sites will concurrently increase the number of salmonids and green sturgeon that will have possible encounters with the propellers of the tugboats pushing the barges.

As construction operations will be occurring at times to avoid peak migration of all listed species, the interactions with the project-related barge traffic will be minimized to the extent possible. As barges will be traveling within the Delta and mainstem Sacramento Rivers, the channel width and depth should allow adult fish the opportunity to swim out of the path of the propellers and avoid injury. Smaller fish may not have the swimming capacity to evade the propeller and may be injured or killed. As barge trips could total up to 2,325 trips from the San Francisco area up to the action area and back down over a total of 5 years of construction, there will be an increased chance for injury or death to fish encountered in those areas. A small number of juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon are expected to be injured or killed each year during the construction phases of the Proposed Action due to propeller strikes caused from proposed action barge traffic.

*Fish Passage Facility Operations*

Fish passage effects are expected to be limited to the Sacramento River and Bypass.

Operation of the proposed fish passage structure will provide improved connectivity for ESA-listed fish species to enter the Sacramento River from the Yolo Bypass. As the Sacramento bypass has had a historic occurrence of stranding both adult and juvenile fish (Johnston et al. 2020), the facility and connection of the fish passage channel to Tule canal is expected to reduce both adult and juvenile stranding. This enhanced connectivity should increase individual survival, as well as potentially increase spawning success of fish that migrate through the Yolo Bypass. While the fish passage facility is not likely to completely remedy the existing stranding occurrences along the Sacramento Weir and Bypass, it is expected to considerably improve conditions and greatly reduce stranding. As such, fish rescues are anticipated to be less of a need as a result of this project component.

The fish passage facility is designed to reduce the frequency and likelihood of stranding that has historically occurred on these types of fish passage structures. The slide gate closure may cause impingement in rare cases, but as the gates will only be closed at very low water levels, fish are expected to generally be able to swim away from the gates during closing. While cases may be low, because this facility is expected to be operated for the next 50 years or longer, it is expected that a small number of adults and juveniles would be impinged on a gate at the new fish passage facility over the life of the project.

Potential issues that may occur with the facility include gate failures, debris blockages, or other damage that may fail to allow the facility to operate as intended. While the proposed O&M actions are expected to resolve these issues, adverse effects to fish may occur in the time it takes for such issues to be safely corrected. In these types of situations, passage delays through the facility are expected. Delays may include adults and juveniles becoming stranded within the Bypass. Risks to juveniles in this situation include impingement on debris/blockage if the facility is clogged with debris, and possible stranding if the facility is not operating correctly (Gregory et al. 1992). These situations may cause death or severe injury when they occur. For adults delayed by malfunction of the facility, they may have an opportunity to turn around and attempt passage through the Fremont Weir if it is operating. If the blockage is not able to be cleared in a timely manner, it may cause severe delays in spawning, death, straying, or inability to reach spawning grounds. While these types of occurrences are not expected annually, the Sacramento River has a high debris load, so this type of blockage is likely to happen several times, resulting in injury or preventing spawning for small numbers of adult fish over the life of the project (50 years or longer).

USACE's proposed action includes the adaptive management of the facility in order to reduce adverse effects, and maximize passage. The adaptive management plan includes flexible operations of the gates in coordination with NMFS technical staff, and is not expected to have any additional effects to species other than those described above.

### 2.5.2. Effects to Designated Critical Habitat

Critical habitat has been designated within the Action Area for SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. The general PBFs of critical habitat within the Action Area are rearing and migratory corridors. Spawning habitat PBFs are present on the American river for CCV steelhead.

*Placement of Riprap*

Effects from Riprap placement activities are expected within the entirety of the Action Area, including the Lower American River.

The continual input of riprap into the Sacramento and American rivers will permanently degrade rearing and migration critical habitat PBFs in the system. Garland et al. (2002) found that juvenile salmonids are significantly less likely to be found in riprap habitats versus unaltered habitats. The study found that as substrate size decreased, likelihood of fish presence increased (until reaching sand substrate). Placement of riprap is expected to adversely affect the value of freshwater migratory and rearing habitat PBFs for juvenile salmonids and reduce the amount of accessible rearing habitat. Placement of riprap is also expected to adversely affect the amount of salmonid spawning habitat available within the American River. No spawning habitat is present within the Sacramento River portions of the Action Area. Placement of riprap will also reduce sediment quality for green sturgeon and change the substrate type or size in areas it is placed, which could reduce food availability and affect water quality and flow. Instream rock placement will cause impacts to rearing habitat quality from reduced abundance of benthic aquatic macroinvertebrates within the footprint of the repairs, due to the placement of rock over the existing streambed. Increased sediment size also creates more habitat for predators to hide and ambush prey from, causing an increase in juvenile predation. These effects to aquatic macroinvertebrates are expected to be long-term as permanent bank armoring alters the natural streambed (USFWS, 2004). The amount of food available for adult and juvenile salmonids and sturgeon in the Action Area is therefore expected to be permanently decreased (habitat quantity and quality) where submerged riprap is placed.

In some areas, riprap will be buried and formed into a launchable trench to protect the levee in case of future erosion. While this type of construction is not anticipated to have negative impacts on salmonid habitat initially, it is designed to launch rock down the bank to protect it in case of scour. These designs are intended to launch over the next 50 years, and vary in their durability to launch on a 10-year flood or higher flow in some scenarios. Due to expected changing water conditions from climate change (described in Section 2.6.5 below), high flow events are expected to occur more frequently, making the launching of these sites even more likely. Once launched, these sites will permanently lose exposed native soil, riparian vegetation, and native habitat function. This will cause permanent reduction in the quality of migratory and rearing habitat. As sites may span for long distances (over 1 mile), or back up right to another site to span several miles, this reduction in quality of habitat may substantially reduce food availability throughout the entirety of the action area.

Another form of rock protection being used is launchable toe rock. This rock, while buried mostly under the planting benches, is also designed to launch to protect the levee from scour. The launching of this type of stone is likely to result in the loss of some of the mitigation planting bench. As this bench is being created to offset the loss of habitat and create some relief habitat among riprap, it is of high value in a system that is so constrained by levees already. As these benches are being constructed to offset the impacts of habitat loss, the lack of durability of this mitigation is concerning. As it cannot be accurately determined at what future time this planting bench will be damaged from launchable rock, the overall long-term benefit of the mitigation becomes less certain. It is assumed that there will be some temporal benefits as opposed to without the bench, but no new habitat will be created and maintained permanently.

Within the Sacramento River, up to 32 acres of permanent degradation of salmonid and sturgeon critical habitat from riprap placement is expected. Within the lower American River, approximately 28 acres will have permanent habitat degradation due to rock placement. Due to the close proximity of all the sites, the degradation of rearing and migratory corridor habitat PBFs in the action area will result in reduced growth, reduced survival, and reduced fitness. While effects will be minimized by the use of BMPs such as soil-filled rock, replanting disturbed areas, and minimizing vegetation removal overall, USACE also proposes to mitigate unavoidable habitat impacts with a combination of on-site planting bench creation, off-site mitigation, or purchase of conservation bank credit.

*Toxic Substance Spills*

Toxic substance effects could occur within the entirety of the Action Area, including the Lower American River.

Operation of power equipment, such as an excavator, in or near aquatic environments increases the potential for toxic substances to enter the aquatic environment and have negative effects on ESA-listed anadromous fish species and designated critical habitat (Feist et al. 2011). Spills of toxic substances could negatively affect the freshwater migratory corridor and freshwater rearing habitat PBFs.

Equipment refueling, fluid leakage, and maintenance activities within and near the stream channel pose some risk of contamination and potential impacts to listed fish species. The Proposed Action includes the development of a hazardous materials spill prevention and countermeasures plan. The Proposed Action includes daily inspections of all heavy equipment for leaks. With inclusion of these measures, the potential effects from hazardous materials entering the aquatic environment and adversely affecting designated critical habitat are not expected to occur.

*Loss of Riparian Habitat Functions and Vegetation*

Degradation of rearing and migratory habitat will occur, resulting from riparian habitat loss within the entirety of the Action Area, including the Lower American River.

During the development of the Recovery Plan for Central Valley Chinook Salmon and Steelhead (NMFS 2014), loss of riparian habitat and instream cover was identified as a primary stressor affecting the recovery of the species. This threat primarily affects the juvenile rearing and outmigration life stage of these species, from the upper reaches of their watershed of origin through the Delta.

Woody debris and overhanging vegetation within shaded riverine aquatic habitat provide escape cover for juvenile salmonids from predators as well as thermal refugia. Aquatic invertebrates are dependent on the organic material provided by a healthy riparian habitat and many terrestrial invertebrates also depend on this habitat. Studies by the California Department of Fish and Wildlife (CDFW) as reported in NMFS (NMFS 1997) demonstrated that a significant portion of juvenile Chinook salmon diet is composed of terrestrial insects, particularly aphids which are dependent on riparian habitat.

The Proposed Action will remove and reduce riparian habitat within designated critical habitat for spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon in the Action Area. While not all SRA habitat will be disturbed during project activities, a significant portion is likely to be impacted. These modifications to designated critical habitat are expected to reduce the PBFs of rearing habitat (reduced quantity and quality, increased predation, reduced cover, and reduced benthic invertebrate production), and will also adversely affect the PBFs of migratory habitat by decreasing the habitat quality. Potential adverse impacts to PBFs of rearing habitat include reduced benthic invertebrate production, disrupted migration, and/or displacement (resulting in increased predation).

Impacts to rearing habitat and migratory corridor PBFs are expected to occur through reduced riparian vegetation, both temporary and permanent. Loss of riparian vegetation is expected to result from maintaining temporary access points to the river, and covering vegetation with gravel/rock. While vegetation removal will be minimized to the maximum extent possible, large-scale riparian vegetation removal will be needed throughout the course of the construction sequences. The impacts to rearing habitat and migratory corridor PBFs from loss of riparian habitat, including that which provides SRA functions, is expected to cause short- and long-term loss in quality habitat. Degraded SRA habitat will affect migrating and rearing fish through loss of food input, cover, and cooling from shade. This is expected to result in reduced feeding/growth, increased predation, and reduced survival. Unavoidable adverse effects will be compensated through a combination of on-site, off-site, and/or mitigation bank credit purchases.

Fish being exposed to the areas losing riparian habitat may be more susceptible to predators due to loss of cover and have changes to their food foraging behavior. Windell et al. (2017) focused on the growth and condition of juveniles as being affected by access to riparian habitats. Habitats that provide refuge from high water velocity or predators, without depleting food supply, function to increase growth rates by reducing energy demand to obtain a given food supply. Growth rate may then influence migration timing and success, where a higher growth rate is associated with earlier smoltification and faster downstream migration [increasing survival] (Beckman et al. 2007).

Impacts to existing vegetation will be avoided to the extent practicable. The loss of riparian vegetation may occur creating and maintaining temporary access points to the river, and placement of riprap or other bank armor. As the overall spatial aspect of the Proposed Action is extensive, the total loss of riparian vegetation is expected to be substantial. With the amount of vegetation potentially needing to be removed throughout such a long stretch of migratory corridor, the ability of the PBFs to support listed fish will diminish. Proposed O&M will cause intermittent small-scale removal of riparian vegetation to maintain maintenance roads over the lifetime of the proposed action. Proposed operations and maintenance will cause intermittent small-scale vegetation removal and trimming over the lifetime of the proposed action. Vegetation removal and trimming will only occur to maintain the access roads as described in the engineering designs for each site. No vegetation removal is anticipated beyond what is described in the proposed action.

Permanent habitat loss is expected to occur at sites where rock is being placed within existing riparian habitat and where rock is replacing or being added onto existing levee banks. On-site and off-site mitigation is proposed to offset impacts that are both temporary and permanent. Planned repair sites are spaced out, such that preferable rearing and migratory corridor PBFs are available between bank repair sites, providing support for listed fish. In areas where bank repair occurs for longer reaches, on-site planting benches will provide support for rearing and migratory habitat through the action area. Degradation of rearing and migratory corridor PBFs of critical habitat will occur, resulting from riparian habitat loss of up to 121 acres within the entirety of the Action Area.

*Increased Mobilization of Sediment*

Effects of sediment mobilization are expected to occur within the entirety of the Action Area, including the Lower American River.

All project sites with waterside repairs will have temporary increases in turbidity and suspended sediment levels within the project work site and downstream areas. The re-suspension and deposition of instream sediments is expected to occur from construction equipment and rock entering the river. The deposition of sediment is expected to temporarily reduce food availability and feeding efficiency due to the natural substrate being coated with a new layer of sediment. Short-term increases in turbidity and suspended sediment levels associated with construction may negatively impact rearing habitat PBFs temporarily through reduced availability of food and reduced feeding efficiency. Short-term increases in turbidity and suspended sediment will also disrupt the ability of rearing habitat to support feeding fish resulting in avoidance or displacement from preferred habitat.

Incorporation of the BMPs described above in section 1.3.2.6 is expected to minimize the extent of adverse effects to critical habitat PBFs to a minimal level. Proposed operations and maintenance at levees and the Sacramento Weir will cause intermittent small-scale increases in turbidity over the lifetime of the proposed action. While small increases in turbidity may cause some short-term, localized disturbances to habitat resulting in temporary adverse effects, it is not expected to cause any long-term impacts resulting in adverse effects to critical habitat.

*Acoustic Impacts*

Effects of acoustic disturbance to critical habitat are expected within the entirety of the Action Area, including the Lower American River.

Impacts to freshwater rearing habitat and migratory corridor PBFs are expected to occur due to pile-driving activities. As a result, we anticipate some localized reduction in the quality of habitat within the Action Area during construction activities. Similarly, construction activities carried out in close proximity to the river channel have the potential to transfer kinetic energy through the adjoining substrates, disturb the water column, and temporarily generate increased turbulence and turbidity in the river (Kemp et al. 2011), affecting the ability of rearing and migratory PBFs to support fish.

Any excessive noise or vibrations may temporarily reduce usage of the habitat within the Action Area. Suitable habitat adjacent to the worksite either upstream or downstream will likely be less utilized if machinery noise is present. Critical habitat effects from noise, motion, and vibration are expected to be temporary and minimal. Proposed O&M will cause intermittent small-scale increases in noise over the lifetime (at least 50 years) of the proposed action. While small increases in noise may cause some localized behavioral disturbances, they are not expected to result in adverse effects to critical habitat PBFs.

*Inaccessible Floodplain for Rearing*

Inaccessible floodplain habitat effects are expected within the entirety of the Action Area, including the Lower American River.

The Proposed Action includes large-scale bank armoring within the Action Area. Bank armoring halts the meander migration and reworking of floodplains, which eventually reduces habitat renewal, diversity, complexity, and heterogeneity. This, in turn, has adverse effects on aquatic ecosystems, ranging from carbon cycling to altering salmonid population structures and fish assemblages (Schmetterling 2001; USFWS 2004). Riprapping decreases river sinuosity, which increases the river channel slope, increasing the bedload transport and possible bed degradation and scour near the toe of the riprapped bank (USFWS 2004).

Loss of floodplain habitat and loss of wetland function have been identified as primary stressors affecting the recovery of Central Valley salmonid species (NMFS 2014), and green sturgeon

(NMFS 2018). This threat primarily affects the PBFs of juvenile rearing and outmigration life stage of these species, from the upper reaches of their watershed of origin through the Delta. Effects of the action that contribute to the Loss of Floodplain Habitat are likely to result in a probable change in fitness of reduced growth and/or reduced survival probability.

Although riverine floodplains support high levels of biodiversity and productivity, they are also among the most converted and threatened ecosystems globally (Opperman et al. 2010). In California, more than 90% of wetlands have been lost since the mid-1800s (Hanak et al. 2011, Garone 2013). Loss of Floodplain Habitat within the Central Valley is a result of controlled flows and decreases in peak flows, which have reduced the frequency of floodplain inundation resulting in a separation of the river channel from its natural floodplain. Channelizing the rivers and Delta has also resulted in a loss of river connectivity with the floodplains that otherwise provide woody debris and gravels, that aid in establishing a diverse riverine habitat, and that provide juvenile salmonid rearing habitat.

The importance of connectivity for juvenile Chinook salmon to floodplain rearing habitat has been observed in several river systems. Research on the Yolo Bypass, the primary floodplain on the lower Sacramento River, indicates that floodplains are key juvenile rearing habitats supporting significantly higher drift invertebrate consumption and therefore faster growth rates (Sommer et al. 2001, Katz et al. 2017). Otolith microstructure studies near the City of Chico recorded increased fall-run Chinook salmon growth, higher prey densities, and warmer water temperatures in off-channel ponds and non-natal seasonal tributaries compared to the main-channel Sacramento River (Limm and Marchetti 2009). Research of juvenile Chinook salmon on the Cosumnes River noted that ephemeral floodplain habitats supported higher growth rates for juvenile Chinook salmon than more permanent habitats in either the floodplain or river (Jeffres et al. 2008). This growth is important to first year and estuarine survival, factors that may be key influences of a Chinook cohort's success (Kareiva et al. 2000).

The Proposed Action will extend the useful life of over 20 miles of levees within listed species critical habitat, continuing blocking of access to historic floodplain rearing habitat PBFs. Although the proposed repairs include compensatory mitigation for permanent impacts at each repair site, extending the useful life of levees in the Action Area results in continued degraded quality and quantity of rearing habitat PBFs for juveniles.

*Beneficial and Compensatory Effects of Proposed Mitigation Activities*

Beneficial and compensatory effects of proposed mitigation effects are expected within the entirety of the Action Area, including the Lower American River.

The Proposed Action includes several aspects that will either restore lost habitat on-site, create new habitat off-site, or otherwise improve habitat for salmonids and green sturgeon. While many of these aspects will require construction and have impacts described above, there will be benefits to the habitat as well. The associated timing of the different aspects of mitigation proposed in the BA are planned to minimize temporal effects. As described above in section 2.1.1 Compensation Timing, reducing impacts ensures a single generation is not exposed to project effects multiple times in their lifetime. Ensuring that the riparian vegetation within migration corridors are returned to a functional level prior to, or within a few years of impacts occurring, ensures that fish exposed to impacts as juveniles, will not be exposed again as returning adults, which could compound the effects and significantly reduce growth and survival.

Planting benches with woody riparian vegetation and lower Tule vegetated benches are being included with the proposed action design when space within the levee prism (entirety of the levee) allows for it. These benches will allow for functional habitat within the levee repair, alleviate some of the effects of the riprap placement, and reduce the overall loss of riparian vegetation. This can provide improved PBFs, when compared to a bare rock slope alternative, for migratory corridor and juvenile rearing.

Beyond the on-site replanting, local mitigation sites are being proposed to compensate for unavoidable permanent effects. The ARMS location being proposed is converting a mine pit into accessible floodplain habitat that will be used for juvenile rearing and migration. This site will create 66 acres of high-quality salmonid habitat that was previously inaccessible. The SRMS location will create 20 acres of habitat containing tidal channels and wetlands that will be used for juvenile rearing and migration.

While designs are not yet final, effects of construction based on the bounds of the described sites can be anticipated. Returning a large site to floodplain habitat can be expected to cause localized increases in turbidity during excavation and grading activities, increased noise, potential cofferdam placement, and other activities as described above. As the sites are likely going to be dry during construction, effects to critical habitat are expected to be temporary and minimal.

Another component of the USACE mitigation proposal is a research grant in the sum of $5 million. This grant funds the on-going green sturgeon research at UC Davis to determine juvenile screening criteria, and begin the process of developing adult green sturgeon passage criteria. By determining accurate juvenile screening criteria, juvenile migratory habitat will greatly increase in safety, as pumping activities will not cause as high of a risk for rearing and migratory corridor PBFs. Being able to accurately determine successful passage mechanisms will increase the PBFs for passage and adult migration by ensuring proper criteria and minimizing delays to migration.

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

### 2.6.1. Water Diversions and Agricultural Practices

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, 2014). In 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). More recent data show that over 95 percent of the now over 3,700 water diversions on the Sacramento and San Joaquin rivers, their tributaries, and the Delta, remain unscreened (CalFish 2019). The impacts from unscreened water diversions have improved due to the anadromous fish screen program, part of CVPIA, as well as DWR's fish screening program (Meier 2013). While private irrigation diversions in the Delta are mostly unscreened, the total amount of water diverted onto Delta farms has remained stable for decades (Culberson et al. 2008). A study of a dozen unscreened diversions in the Sacramento River, all relatively deep in the channel, reported low entrainment for listed salmonids and steelhead (Vogel 2013).

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, Stanislaus River, San Joaquin River, and Delta. Grazing activities from dairy and cattle operations can degrade or reduce suitable critical habitat for listed fish species by increasing erosion and sedimentation. These practices introduce nitrogen, ammonia, and other nutrients into the watershed, which then flow into receiving waters (Lehman et al. 2014). Ammonia introduction from agricultural activities can be additive with much larger sources, such as wastewater treatment discharges.

Salmonids and sturgeon exposure to contaminants is inherent in the Delta, ranging in the degree of effects. Stormwater and irrigation discharges related to agricultural activities contain numerous pesticides, herbicides, and other contaminants that may disrupt various physiological mechanisms and negatively affect reproductive success and survival rates of listed anadromous fish (Dubrovsky 1998, Scott and Sloman 2004, Whitehead et al. 2004, Scholz et al. 2012). Agricultural operations outside the action area can result in discharges that flow into the action area and contribute to cumulative effects of contaminant exposure. The State of California issues waste discharge requirements to dischargers, including irrigators, dairy operations, and cattle operations, that require the implementation of best management practices designed to protect surface water quality, with benefits for listed fish species. Agricultural operations have monitoring and reporting requirements associated with those waste discharge requirements that ensure compliance with best management practices.

### 2.6.2. Increased Urbanization and Municipal Water Treatment

California's current population is approximately 39.1 million people. California's population declined during the COVID-19 era, with the largest decrease during the first year (-0.75 percent in fiscal year 2020–2021). Despite the effect of COVID-19, the California Department of

Finance projects that California's population will increase to 40.2 million in 2044, and then decrease to 39.6 million by 2060 (California Department of Finance 2023). The increase between now and 2044 will likely be accompanied by increases in urbanization and housing developments. The Delta, East Bay, and Sacramento regions include portions of Alameda, Sacramento, San Joaquin, Solano, Stanislaus, Yolo, and Yuba counties. Population growth rate was highest in Yuba County (0.76 percent; California Department of Finance 2023).

Increases in urbanization and housing developments can 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, highways, and public utilities. Some of these actions, particularly those situated away from waterbodies, will not require federal permits and thus will not undergo review through ESA section 7 consultations.

Negative effects on listed fish species and their critical habitats may result from urbanization-induced point and non-point source chemical contaminant discharges within the action area. These contaminants, which include, but are not limited to, ammonia and free ammonium ion, numerous pesticides and herbicides, and oil and gasoline product discharges, may disrupt various physiological mechanisms and may negatively affect reproductive success and survival rates of listed anadromous fish (Dubrovsky 1998, Scott and Sloman 2004, Whitehead et al. 2004, Scholz et al. 2012).

Wastewater treatment plants have received special attention because of their discharge of ammonia into the Sacramento River. The EPA published revised national recommended ambient water quality criteria for the protection of aquatic life from the toxic effects of ammonia in 2013. 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 (Eddy 2005, Connon et al. 2011).

Werner et al. (2008, 2009, 2010) analyzed the acute effects of Sacramento Regional Wastewater Treatment Plant effluent on Delta smelt, rainbow trout, and fathead minnow. The studies found that at ammonia/um concentrations reported downstream of the discharge, on average below 1 milligrams per liter ammonia/um, lethal toxicity effects are not expected. In general, this lack of toxicity was attributed to the fact that the lethal concentration at which 50 percent of individuals exposed die (i.e., LC50 values) was much higher than ammonia concentrations reported in environmental sampling. However, the studies did not assess sublethal toxicity. Sublethal ammonia toxicity at concentrations similar to what had been reported downstream of Sacramento Regional Wastewater Treatment Plant (less than 1 milligrams per liter) has been demonstrated in fish. In a study of coho salmon and rainbow trout exposed to ammonia, Wicks et al. (2002) showed a decrease in swimming performance due to metabolic challenges and depolarization of white muscle, and found that ammonia was significantly more toxic for active fish. Furthermore, fish exposed to sublethal concentrations of ammonia/um have exhibited increased respiratory activity and heart rate, loss of equilibrium, and hyper-excitability (Eddy 2005). None of these studies assessed the chronic effects of ammonia/um exposure that may occur at lower concentrations on the behavior, reproduction, or long-term survival of ESA-listed or surrogate species. However, Werner et al. (2009) concluded that “ammonia/um concentrations detected in the Sacramento River below the Sacramento Regional Wastewater Treatment Plant are of concern with respect to chronic toxicity to Delta smelt and other sensitive species.”

The Sacramento Regional Wastewater Treatment Plant, in order to comply with Order no. R5-2013-0124, began implementing compliance measures to reduce ammonia discharges. Construction of treatment facilities for three major projects required for ammonia and nitrate reduction was initiated in March 2015 (Sacramento Regional County Sanitation District 2015). The order was modified in October 2013 by the Central Valley Regional Water Quality Control Board to impose new effluent limitations, requiring effluent limits for ammonia of 2.0 milligrams per liter per day from April to October, and 3.3 milligrams per liter per day from November to March (Central Valley Regional Water Quality Control Board 2016). However, the board concluded that compliance with these effluent limitations was not feasible, and put the plant in non-compliance with the ammonia final effluent limitations. In September 2020, the Sacramento Regional Wastewater Treatment Plant requested a Time Schedule Order to extend the compliance schedule to allow additional time to complete upgrades to the Facility. Time Schedule Order R5-2020-0904 was issued on December 4, 2020, which provided a schedule to achieve compliance with final effluent limitations for ammonia by June 1, 2022 (Central Valley Regional Water Quality Control Board 2020). As of spring 2023, the Sacramento Regional Wastewater Treatment Plant completed extensive upgrades, and the treatment process now removes 99 percent of ammonia.

### 2.6.3. Non-Federal Rock Revetment and Levee Repair Projects

Cumulative effects include non-Federal riprap projects. Depending on the scope of the action, some non-Federal riprap projects carried out by state or local agencies do not require Federal permits. These types of actions and illegal placement of riprap occur throughout the action area. For example, most of the levees have roads on top of the levees that are maintained either by the county, reclamation district, owner, or by the state. Landowners may utilize and modify roads at the top of the levees to access part of their agricultural land. The effects of such actions result in continued fragmentation of existing high-quality habitat, and conversion of complex nearshore aquatic to simplified habitats that affect salmonids in ways similar to the adverse effects associated with this project.

### 2.6.4. Global Climate Change

Warming attributed to climate change is expected to affect Central Valley anadromous salmonids and sDPS green sturgeon more than it already has. Because the Central Valley salmon, steelhead, and green sturgeon runs are restricted to low elevations as a result of impassable dams, if the climate warms by 5°C (9°F), it is questionable whether any Central Valley Chinook salmon and sDPS green sturgeon populations can persist (Williams 2006, NMFS 2018). Based on an analysis of an ensemble of climate models and emission scenarios and a reference temperature from 1951 to 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 can support salmonid life stages. Projected 33 percent salinity increases in the Sacramento river basin in the 21st century due to climate change may result in declining habitat quality and food web productivity; climate change will alter the salinity and prey base in sDPS green sturgeon juvenile rearing habitat and adult migration corridors (CH2M HILL 2014, NMFS 2018).

There is also a high threat posed by altered water temperatures due to climate change. In the Sacramento river basin, climate change models predict increased air temperatures in the Central Valley and surrounding mountains (Ficklin et al. 2012), altered precipitation patterns with a higher frequency of dry years, reduced spring snowpack, and reduced spring flows (Knowles and Cayan 2002, CH2M HILL 2014). Water temperatures in the Sacramento river basin could also increase (CH2M HILL 2014). A warming climate with continued changes in precipitation patterns may influence reservoir operations and thus influence water temperature and flow that fish experience in the Central Valley.

Growth and survival rates of salmon in the California Current off the Pacific Northwest can be linked to fluctuations in ocean conditions related to Pacific Decadal Oscillation and the El Nino-Southern Oscillation conditions and events, as well as the recent northeast Pacific marine warming phenomenon (also known as “the blob”; Wells et al. 2008, Peterson et al. 2017). Evidence exists that suggests early marine survival for juvenile salmon is a critical phase in their survival and development into adults.

In marine environments, ecosystems and habitats important to juvenile and adult salmonids are likely to experience changes in temperatures, circulation, water chemistry, and food supplies (Feely 2004, Brewer and Barry 2008, Osgood 2008, Turley 2008, Abdul-Aziz et al. 2011, Doney et al. 2012). Some of these changes, including an increased incidence of marine heat waves, are likely already occurring, and are expected to increase (Frolicher et al. 2018).

The correlation between various environmental indices that track ocean conditions and salmon productivity in the Pacific Ocean, both on a broad and a local scale, provides an indication of the role they play in salmon survival in the ocean. Moreover, when discussing the potential extinctions of salmon populations, climate patterns would not likely be the sole cause, but could certainly increase the risk of extinction when combined with other factors, especially in ecosystems under stress from humans (Francis and Mantua 2003).

## 2.7. Integration and Synthesis

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

### Summary of the Status of the Species, Environmental Baseline and Cumulative Effects

The viability of the SR winter-run and CV spring-run Chinook salmon, and CCV steelhead ESUs have deteriorated in recent years (NMFS 2016; Johnson et al. 2023). The largest impacts are likely due to the 2012-2015 and 2020-2022 freshwater drought conditions and unusually warm ocean conditions experienced by these cohorts. The ESUs continue to face significant, unyielding threats that are likely to be exacerbated by the impacts of future climate change (Crozier et al. 2019). Based on the current 5-year reviews and more recent data, the ESUs remains at a moderate to high risk of extinction (Johnson et al. 2023, NMFS 2024a, NMFS 2024b). In the action area, water diversions/agriculture, fish hatcheries, and urbanization will continue to affect listed salmon ESUs and the green sturgeon DPS.

Salmon, steelhead, and green sturgeon use the action area as an upstream and downstream migration corridor and for rearing. Within the action area, the essential features of freshwater rearing and migration habitats for salmon, steelhead and green sturgeon have been transformed from a meandering waterway lined with a dense riparian vegetation, to a highly leveed system under varying degrees of constraint of riverine erosional processes and flooding. Levees have been constructed near the edge of the river and most floodplains have been completely separated and isolated from the Sacramento River. Severe long-term riparian vegetation losses have occurred in this part of the Sacramento River, and there are large open gaps without the presence of these essential features due to the high amount of riprap. The change in the ecosystem as a result of halting the lateral migration of the river channel, the loss of floodplains, the removal of riparian vegetation, contribution from the riparian vegetation into the aquatic system, and IWM have likely affected the functional ecological processes that are essential for growth and survival of salmon, steelhead and green sturgeon in the action area.

**Summary of the Effects of the Proposed Action to Listed Species**

Effects of the levee repair on aquatic resources included both short- and long-term impacts. Short-term impacts are those that will occur annually during construction activities to build and repair features, including:

- Physical disturbance: a small number of juveniles of each species will be injured or killed as a result of the physical disturbance and rock placement. Though adults are more likely able to avoid rock placement, a few adults will also be injured or killed due to the large scale of the Proposed Action.
- Increased turbidity: exposure to increased sedimentation and turbidity is expected to be brief and not likely to result in direct mortality but may result in behavioral effects increasing susceptibility to predation.
- Acoustic impacts: a moderate number of fish are expected to be exposed to acoustic noise resulting in localized behavioral disturbances. Injury or lethal effects are expected to occur to a few juvenile fish of each species each year for the course of construction.
- Dewatering and fish relocation: Injury or mortality is expected for a small number of fish related to cofferdam dewatering, pump impingement, and handling/relocation stress.
- Impingement: A small number of juvenile fish exposed to pumping activities for site irrigation are expected to be injured or killed each year from impingement.
- Barge traffic: exposure to increased barge traffic will result in small numbers of each species to be injured or killed each year due to propeller strikes.

Long-term impacts are those which will continue into the future following completion of construction, including:

- Continued blockage to the floodplain: extending the useful life of over 20 miles of levees within listed species critical habitat will continue blocking access to historic floodplain rearing habitat resulting in continued degraded quality and quantity of habitat for juveniles, contributing to reduced growth, survival, and fitness of the species.
- Stranding: a small number of fish are expected to be stranded at the Sacramento Weir/Sacramento Bypass and the berm located at contract 4A on the Lower American River, resulting in injury or death.
- Long-term operations and maintenance: a small number of juvenile and adult fish may experience migration delays, injury, or death related to the operations and maintenance of the Sacramento Weir fish passage structure.

As described above, the risk to SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon posed by the proposed action is evaluated in the aggregate context of the species' status, the environmental baseline, cumulative effects, and effects from other activities that would not occur but for the Proposed Action and also reasonably certain to occur. As the Sacramento River portion of the Action Area is the main migratory corridor for all of the species' established populations in the Sacramento River watershed, any reduction in habitat quality can be highly detrimental to the ESUs. The Action Area is the migratory corridor that is used by both adults and juveniles, and continued blockage of access to historical floodplain habitat is a stressor that will be reinforced by the implementation of proposed action.

**Summary of the Effect of the Proposed Action to Critical Habitat**

Within the action area, the general relevant PBFs of the designated critical habitat for listed salmonids are spawning habitat, migratory corridors, and rearing habitat, and for green sturgeon, the six PBFs include food resources, water flow, water quality, migratory corridor, depth, and sediment quality.

As described in the project description, this consultation analyzed a number of repair designs, which involve vegetation removal, bank fill stone protection installation of rock revetment, and potentially limited replacement of on-site habitat features, resulting in loss of SRA habitat and IWM at the project sites. These actions are expected to temporarily or permanently reduce the quality of habitat for rearing and migrating juvenile salmonids, due to the removal of SRA habitat and IWM. SRA habitat and IWM are important for rearing and out-migrating juvenile salmonids, because they enhance the aquatic food webs and provide high-value feeding areas for juvenile salmonids. Removal of SRA habitat and IWM is expected to temporarily reduce the growth and survival for juvenile salmonids exposed to the project sites.

Similarly, SRA habitat and IWM are critical in providing shade and cooling water temperatures for salmonids. Therefore, the removal of SRA habitat and IWM associated with the repairs will degrade freshwater rearing and migratory corridors for listed salmonids by temporarily increasing temperatures. The removal of IWM will also increase the risk of predation for juvenile salmonids. The Proposed Action further perpetuates the confinement of rivers within their banks, reducing river connectivity with adjacent floodplains, which serve as optimal rearing habitat. The severity of these effects and whether they are temporary or permanent is dependent on the repair type chosen at each site.

Green sturgeon PBFs of food resources are expected to be adversely affected by the proposed program, as program features will cover the soft benthic substrate where green sturgeon forage for food with riprap, reducing food availability. The lack of scientific information regarding bank protection actions on green sturgeon makes the extent of effects difficult to quantify. Ongoing efforts through the green sturgeon HMMP will develop methodology for quantifying and mitigating these effects.

Up to 65.5 acres of permanent degradation of salmonid and green sturgeon critical habitat from riprap placement is expected. This will result in reduced growth, reduced survival, and reduced fitness of the species. Permanent habitat loss is expected to occur at sites where rock is being placed within existing riparian habitat and where rock is replacing or being added onto existing levee banks. Degradation of rearing and migratory corridor PBFs of critical habitat will occur, resulting from riparian habitat loss of up to 65.5 acres within the entirety of the Action Area.

Based on the proposed action, unavoidable impacts will be offset/mitigated at no less than a 1:1 ratio for each acre impacted.

**Risk to the ESU/DPSs and Critical Habitats at the Designation Level**

Based on reach-specific analysis of long-term project-related impacts to each analyzed species we determine that there will be appreciable adverse effects to each species in nearly all reaches and water surface elevations. Adverse effects at various water surface elevations, regions, and life stages are expected to last in many cases for several decades, affecting a high proportion and multiple generations of the species analyzed in this opinion.

Most of the effects are related to long-term impacts to riparian habitat and IWM, as well as the continued lack of access to floodplain habitat. The perpetuating effects of the USACE Levee Vegetation Policy and riprap placement are clearly driving those effects.

Depending on final site designs, the effects of the proposed action could exacerbate stressors/threats to SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. Through conscientious design in coordination with NMFS and the mitigation procedures included in the proposed program, these impacts are expected to be minimized, with unavoidable impacts mitigated. Considering that site-specific actions will occur along primary migratory corridors of the Sacramento River, we expect that all Sacramento River Basin populations of these species have the potential to be exposed and adversely affected by program actions. With the nature and potential duration of the effects, we expect the proposed action to temporarily reduce the productivity of a portion of each species exposed to a project site during construction for the first five years as revegetation occurs. However, based on the proposed action, unavoidable impacts will be mitigated, such that the project is not expected to reduce appreciably the likelihood of both the survival and recovery of the species, nor appreciably diminish the value of designated critical habitat as a whole for the conservation of the species.

## 2.8. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and the cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, sDPS North American green sturgeon or destroy or adversely modify their designated critical habitat.

## 2.9. Incidental Take Statement

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

### 2.9.1. Amount or Extent of Take

While individual fish are expected to be present in the Action Area at the time of construction, and during seasonal rearing and migration, NMFS cannot, using the best available information, precisely quantify and track the amount or number of individuals that are expected to be incidentally taken (injure, harm, kill, etc.) per species as a result of the proposed action. This is due to the variability and uncertainty associated with the response of listed species to the effects of the proposed action, the varying population size of each species, annual variations in the timing of spawning and migration, individual habitat use within the Action Area, and difficulty in observing injured or dead fish. However, it is possible to estimate the extent of incidental take by designating as ecological surrogates, those elements of the project that are expected to result in incidental take, that are more predictable and/or measurable, with the ability to monitor those surrogates to determine the extent of take that is occurring.

The most appropriate threshold for incidental take is an ecological surrogate of habitat disturbance, which includes the loss of SRA cover and riparian habitat through the placement of rock revetment and removal of vegetation. This degradation is expected to result in reduction in the growth and survival of individuals from predation, or by causing fish to relocate and rear in other locations and reduction of the quantity and quality of the existing habitat.

Incidental take, in the form of harm resulting in behavioral modifications or fish responses to habitat disturbance are described as follows. Increased predation (decreased survival) is expected to occur during the construction phase due to construction-related disturbance and shoreline activity. Long-term behavioral modifications and increased predation vulnerability resulting from loss and degradation of shoreline riparian habitat and shallow water habitat is also expected to occur throughout the life of the levee. Quantification of the number of fish exposed to noise, shoreline activities, and increases in predation vulnerability is not currently possible with available monitoring data. Observations of individual fish within the river channel are not possible due to water clarity and depth. However, all fish passing through or otherwise present in the Action Area during construction activities or over the long term during their adult and juvenile rearing and migratory life history stages will be exposed to the disturbed shoreline habitat created by the rehabilitation sites. Thus, the footprint of each rehabilitation site defines the area in which projected incidental take will occur for this project due to the effects of construction actions and the long-term habitat disturbance associated with each site. NMFS anticipates incidental take will be limited to the following:

1) Harm to rearing and migrating juveniles is expected within the project footprint for areas below the OHWM due to rock placement within the channel. Rock placement is expected to result in injury or death to a small number of juvenile fish each year in the action area where riprap placement is occurring below OHWM. Harm to rearing juvenile SR winter-run, CV spring-run Chinook salmon, and CCV steelhead, and adult and juvenile green sturgeon from the repair will be limited to a total habitat impact of 65.5 acres below the OHWM. Therefore, anticipated take will be exceeded if rock placement below the OHWM exceeds 31.4 acres within the Sacramento River projects area (mouth of the American River down to the bottom of the action area), 27.61 acres within the American River, or 6.5 acres within the Sacramento Weir and Bypass.

2) Harm to rearing juvenile spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon from increased turbidity in the footprint of the proposed project from construction activities, extending upstream and downstream 1,000 feet from the footprint of each individual site and 100 feet from the extent of the repair into the river channel. This disturbed habitat will affect the behavior of fish, including displacement, which is reasonably certain to result in increased predation, decreased feeding, and increased competition. Quantification of the number of fish exposed to turbidity is not currently possible with available monitoring data. Observations of individual fish within the river channel are not possible due to water clarity and depth. However, all fish passing through or otherwise present during construction activities at the rehabilitation sites will be exposed to construction related turbidity events, particularly when the turbidity curtains are removed. Thus, the waterside footprint of each rehabilitation site plus the additional area of river channel where turbidity effects are expected to be observed defines the area in which projected take will occur for this project due to the effects of construction related turbidity. Anticipated take will be

exceeded if turbidity measured 1,000 feet downstream of the extent of the site exceeds double the upstream of site turbidity measurement.

3) Take in the form of harm, injury and death to listed fish, is expected due to pile driving. Activities will affect adults and juveniles through direct stress, injury, or death. Activities would also cause harm through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Anticipated take will be exceeded if the single strike criteria exposure; a SEL of 187 dB re: 1 $\mu Pa^2$•sec and a peak sound pressure of 208 dB re: 1 µPapeak as measured 10 m from the source is exceeded.

4) Take in the form of harm, injury and death to listed fish, is expected due to dewatering, fish capture, and relocation activities. Activities will affect juveniles and adults through increased stress, injury, or death. Harm is also expected through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Anticipated take will be exceeded if an excess of 2% of a species of fish handled annually are directly killed due to dewatering, capture and relocation activities.

5) Take in the form of harm, injury and death to listed fish, is expected due to fish impingement during pumping activities for riparian irrigation. Activities will affect juveniles through increased stress, injury, or death. Harm from stress or injury is also expected to cause displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Anticipated take will be exceeded if pumping activities occur outside the timeframes indicated below, or above the amounts of water indicated in Table 3.

*Table 3 Estimated Maintenance Schedule for Riparian Habitat.*

| **Monitoring Year** | **Watering**<br>(Years 1 & 2: March 15 – November 15)<br>(Year 3 – 5: April 1 – October 31) |
|---|---|
| Year 1 | 50 gallons per plant or 3-inches of spray applied precipitation every 10 to 14 days |
| Year 2 | 30 gallons per plant or two inches of spray applied precipitation every week to 10 days |
| Years 3 - 5 | 10 gallons per plant or one inch of spray applied precipitation twice a week |

6) Take in the form of injury or death to adults and juvenile CV spring-run, Sacramento River winter-run Chinook salmon, CCV steelhead, and sDPS green sturgeon due to stranding on the declining hydrograph within the 660 acres of the widened bypass. This take is expected to occur when flows are at or above the 2-year flow level, following the spilling of river water and as the flood flows recede stranding these species in the Sacramento Bypass. Anticipated take will be exceeded if stranding of any fish occurs more than every two years within the expanded side of the bypass.

7) Take in the form of harm, injury and death to listed fish, is expected due to fish rescue and relocation within the expanded Sacramento Bypass. Stranding will affect juveniles and adults through increased stress, injury, or death, including from attempted relocation. Harm is also expected through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Anticipated take will be exceeded if an excess of 2% of a species of fish handled annually are killed due to handling subsequent to stranding.

8) Take in the form of harm, injury and death to listed fish, is expected due to increased barge traffic in the Sacramento River. Activities will affect juveniles and adults through increased stress, injury, or death. Harm is also expected through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Anticipated take will be exceeded if total barge trips exceed 2,325 round trips through construction activities.

9) Take in the form of harm, injury and death to listed fish, is expected due to fish passage gate closure at the Sacramento Adult Fish Passage Facility. Activities will affect juveniles and adults through increased stress, injury, or death. Anticipated take will be exceeded if gate closures cause the death of more than one ESA listed fish during each water year.

10) Take in the form of harm, injury and death to listed fish, is expected due to normal operations and maintenance of the Sacramento Adult Fish Passage Facility. Activities will affect juveniles and adults through increased stress, injury, or death. Harm is also expected through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Harm to adults is also expected through delays in spawning and straying. Anticipated take will be exceeded if operations issues are not restored within 24 hours of it being safe to do so (during times when the facility would be operating), or prior to the facility operating (for maintenance needing to be done in the dry season).

11) Harm to rearing juvenile spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and adult and juvenile green sturgeon from the loss of up to 65.51 acres of riparian habitat. This loss will affect juveniles through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Table 4 describes the anticipated area of disturbed habitat representing the ecological surrogate of incidental take at each site location for known project designs within the three main areas of the proposed action. Anticipated take will be exceeded if impacts exceed 31.4 acres within the Sacramento River projects area (mouth of the American River down to the bottom of the action area), 27.61 acres within the American River, or 6.5 acres within the Sacramento Weir and Bypass.

*Table 4 Maximum Acreages to be impacted in different Project Areas*

| Project Area | Permanent Acreages Impact below OHWM |
|---|---|
| Sacramento River | 31.4 acres |
| American River | 27.61 acres |

| | |
|---|---|
| Sacramento Weir and Bypass | 6.5 acres |
| Total: | 65.51 acres |

### 2.9.2. Effect of the Take

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

### 2.9.3. Reasonable and Prudent Measures

"Reasonable and prudent measures" refer to those actions the Director considers necessary or appropriate to minimize the impact of the incidental take on the species (50 CFR 402.02).

1) Measures shall be taken to minimize the impacts of the proposed bank protection construction.

2) Measures shall be taken to ensure necessary monitoring and Management Plans are developed.

3) Measures shall be taken to ensure that contractors, construction workers, and all other parties involved with these projects implement the projects as proposed in the biological assessments and this opinion.

4) Measures shall be taken to monitor incidental take of listed fish and the survival of on-site plantings, reporting of annual repair status, purchase of mitigation credits, and submission of site-specific designs.

### 2.9.4. Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the federal action agency must comply (or must ensure that any applicant complies) with the following terms and conditions. The USACE or any applicant has a continuing duty to monitor the impacts of incidental take and must report the progress of the action and its impact on the species as specified in this ITS (50 CFR 402.14). If the entity to whom a term and condition is directed does not comply with the following terms and conditions, protective coverage for the proposed action would likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1: "*Measures shall be taken to minimize the impacts of the proposed bank protection construction.*"

    a. USACE shall continue to participate in the existing Interagency Working Group (IWG) and Bank Protection Working Group (BPWG) to coordinate stakeholder input into future flood risk reduction actions associated with the American River Common Features GRR. The BPWG will hold technical deliberations over proposed bank protection, including the need (basis of/for design), purpose and proposed designs (emphasis on avoidance and fish-friendly designs). Membership in the BPWG will be subject to agency decisions to participate, but should at a minimum include participation from resource agency staff (USFWS, NMFS, CDFW) and local sponsors (CVFPB and SAFCA.)

b. USACE shall coordinate with NMFS during site designs as future flood risk reduction actions are designed to ensure conservation measures are incorporated and projects are designed to maximize ecological benefits.

c. USACE shall minimize the removal of existing riparian vegetation and IWM to the absolute minimum needed to achieve flood risk management. Where appropriate, removed IWM will be anchored back into place or if not feasible, new IWM will be anchored in place.

d. USACE shall install IWM along all projects associated with the American River Common Features GRR at 40% to 80% shoreline coverage at all seasonal water surface elevations in coordination with the IWG or the BPWG, where site engineering allows for it. The purpose is to maximize refugia and rearing habitat for juvenile fish while promoting natural recruitment of vegetation.

e. USACE shall vary the elevation of planting benches and IWM to accommodate a wide variety of water years and ensure there is ample shoreline habitat in different flow scenarios.

f. USACE shall monitor turbidity during in-water work activities to ensure levels stay below the allowable thresholds (turbidity measured 1,000 feet downstream of the extent of the site is not to exceed double the upstream of site turbidity measurement).

2. The following terms and conditions implement reasonable and prudent measure 2: "*Measures shall be taken to ensure necessary monitoring and management plans are developed.*"
   a. USACE shall develop an HMMP for each on-site and off-site mitigation location, consistent with the 2020 American River Common Features Strategic Approach to Mitigation with the overall goal of mitigating for the impacts to the ecological function and value of the existing levee system within the GRR study area. USACE shall coordinate HMMPs with NMFS prior to the construction of any projects related to the GRR.

   b. USACE shall update the O&M manual to incorporate details regarding the adaptive management plan for operations of the Sacramento Weir that allows for operations of flows in a manner to minimize fish stranding in the Sacramento Bypass.

c. USACE shall ensure all water diversions associated with the O&M of the Sacramento Weir and Bypass are protected by a screen of appropriate size and mesh consistent with NMFS 2023 West Coast Region Anadromous Salmonid Passage Design Manual.

d. Each HMMP measures shall be monitored by USACE for ten years following construction and USACE shall update their O&M manual to ensure the HMMP is adopted by the local sponsor to ensure the goals and objectives of the conservation measures are met for the life of the project.

e. Each HMMP shall include specific goals and objectives and a clear, NMFS-approved strategy for achieving full compensation for all project-related impacts on the affected species described above.

f. Each HMMP shall include a compensatory mitigation accounting plan to ensure the tracking of compensatory measures associated with future American River Common Features GRR projects as described in the proposed action.

g. USACE shall continue to coordinate with NMFS during all phases of construction, implementation, and monitoring by hosting annual meetings and issuing annual reports throughout the construction period as described in the HMMP.

h. USACE shall host an annual meeting and issue annual monitoring reports for five years following completion of project construction. The purpose is to ensure that conservation features of the project are developing consistent with the HMMPs.

i. USACE shall update their O&M Manual to ensure that the mitigation elements are meeting the criteria established in the HMMP.

j. USACE shall provide NMFS a detailed O&M plan for all aspects of the proposed action, to ensure all sites are properly managed and the Design Deviation allowing vegetation to remain is followed. This plan shall be incorporated into the O&M manual for each site to ensure vegetation removal does not occur in the future.

k. USACE shall provide NMFS a Long-Term Management Plan outlining the maintenance of all on-site and off-site mitigation. The plan shall include performance goals, monitoring plans, replanting plans, and an adaptive management plan for how mitigation will be addressed if the mitigation sites fail.

3. The following terms and conditions implement reasonable and prudent measure 3: *"Measures shall be taken to ensure that contractors, construction workers, and all*

*other parties involved with these projects implement the projects as proposed in the biological assessments and this opinion"*

a. USACE shall provide a copy of this opinion, or similar documentation, to the prime contractor, making the prime contractor responsible for implementing all applicable requirements and obligations included in these documents and to educate and inform all other contractors involved in the project as to the requirement of this opinion. A notification that contractors have been supplied with this information will be provided to the reporting address below.

b. A NMFS-approved Worker Environmental Awareness Training Program for construction personnel shall be conducted by the NMFS-approved biologist for all construction workers prior to the commencement of construction activities. The program shall provide workers with information on their responsibilities with regard to federally listed fish, their critical habitat, an overview of the life history of all the species, information on take prohibitions, protections afforded these animals under the ESA, and an explanation of the relevant terms and conditions of this opinion. Written documentation of the training must be submitted to NMFS within 30 days of the completion of training.

4. The following terms and conditions implement reasonable and prudent measure 4: "*Measures shall be taken to monitor incidental take of listed fish and the survival of on-site plantings, reporting of annual repair status, purchase of mitigation credits, and submissions of site-specific designs."*

a. USACE shall monitor conditions on each side of the new Adult Fish Passage Facility (both the channel and the ladder) to ensure NMFS passage criteria are being met.

b. USACE shall initiate an interagency PIT Tag collaborative meeting to occur after each overtopping event at the fish passage facility. The goal of this meeting will be to establish a group where collected PIT tag data may be shared. This meeting shall commence prior to the first operation of the new Sacramento Weir Fish Passage Facility. The planning and initial meeting shall be coordinated with CDFW and NMFS

c. USACE shall ensure that, when conditions are safe to do so, the Sacramento Bypass is surveyed every year after overtopping events and repair any large scour holes or erosion that may cause stranding risk or increase the likelihood of stranding within the expanded Sacramento Bypass.

d. USACE shall provide to NMFS (at the address below) a vegetation monitoring report at years 1, 2, 3, 5, and 8 post-construction no later than December 31st of each reporting cycle. This report shall provide information as to the success of the revegetation program and whether the conservation goals are being met at each site. If goals are not being met, then the report shall indicate what actions are being implemented to meet those goals.

e. USACE shall submit a report to NMFS of any incidental take that occurs as part of the project. This report shall be submitted no later than July 31 of each reporting cycle.

f. USACE shall contact NMFS within 24 hours of the new expanded Sacramento Weir overtopping for the first five years.

g. USACE shall ensure that the NMFS Central Valley Office is involved with the discussions, development, and tracking of the FHAST model development and the UC Davis green sturgeon research.

h. All reports for NMFS shall be sent to:

Cathy Marcinkevage
California Central Valley Office
National Marine Fisheries Service
650 Capitol Mall, Suite 5-100
Sacramento California 95814
FAX: (916) 930-3629
Phone: (916) 930-3600
ccvo.consultationrequests@noaa.gov

## 2.10. Conservation Recommendations

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

1) USACE should integrate the 2017 California Central Valley Flood Protection Plan’s Conservation Strategy into all flood risk reduction projects they authorize, fund, or carry out.

2) USACE should prioritize and continue to support flood management actions that set levees back from rivers and in places where this is not technically feasible, repair in place actions should pursue landside levee repairs instead of waterside repairs.

3) USACE should consult with NMFS in the review of ETL variances for future projects that require ETL compliance.

4) USACE should develop ETL vegetation variances for all flood management actions that are adjacent to any Central Valley anadromous fish habitat.

5) USACE should use all of their authorities, to the maximum extent feasible to implement high priority actions in the NMFS Central Valley Salmon and Steelhead Recovery Plan. High priority actions related to flood management include setting levees back from riverbanks, increasing the amount and extent of riparian vegetation along reaches of the Sacramento River Flood Control Project.

6) USACE should encourage cost-share sponsors and applicants to develop floodplain and riparian corridor enhancement plans as part of their projects.

7) USACE should continue to work with NMFS and other agencies and interests to support the improved growth, survival and recovery of native fish species in the Yolo Bypass and other bypasses within the Sacramento River Flood Control Project, including restoring/improving fish passage.

8) USACE should consider implementing post-construction bathymetry to monitor changes in benthic habitat.

In order for NMFS to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, NMFS requests notification of the implementation of any conservation recommendations.

### 2.11. Reinitiation of Consultation

This concludes formal consultation for the American River Watershed Common Features General Reevaluation Report Reinitiation 2024.

Under 50 CFR 402.16(a): "Reinitiation of consultation is required and shall be requested by the federal agency, where discretionary federal involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

## 3. Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response

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

This analysis is based, in part, on the EFH assessment provided by the United States Army Corps of Engineers and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the Pacific Fisheries Management Council and approved by the Secretary of Commerce.

### 3.1. Essential Fish Habitat Affected by the Proposed Action

The proposed project occurs within EFH for various federally managed fish species within the Pacific Salmon FMP. The geographic extent of freshwater EFH is identified as all water bodies currently or historically occupied by Council-managed salmon as described in Amendment 18 of the Pacific Coast Salmon Plan (PFMC 2014). In the estuarine and marine areas, salmon EFH extends from the extreme high tide line in nearshore and tidal submerged environments within state territorial waters out to the full extent of the Exclusive Economic Zone (EEZ) (200 nautical miles or 370.4 km) offshore of Washington, Oregon, and California north of Point Conception. The proposed project occurs in the area identified as "freshwater EFH", as it is above the tidal influence where the salinity is below 0.5 parts per thousand.

In addition, the project occurs within, or in the vicinity of (1) complex channels and floodplain habitat and (2) thermal refugia, which are designated as a habitat areas of particular concern (HAPCs) for various federally managed fish species within the Pacific Coast salmon FMP. HAPCs are described in the regulations as subsets of EFH which are rare, particularly susceptible to human-induced degradation, especially ecologically important, or located in an environmentally stressed area. Designated HAPC are not afforded any additional regulatory protection under the MSA; however, federal projects with potential adverse impacts on HAPC will be more carefully scrutinized during the consultation process.

### 3.2. Adverse Effects on Essential Fish Habitat

NMFS determined the proposed action would adversely affect EFH as follows:

1) Bank Stabilization and Protection – The proposed project has components that will entail bank stabilization and protection activities in the Action Area which includes freshwater EFH. These activities include placement of rock armoring and removal of riparian vegetation. The alteration of riverine and estuarine habitat from bank and shoreline

stabilization, and protection from flooding events can result in varying degrees of change in the physical, chemical, and biological characteristics of existing shoreline and riparian habitat. Human activities removing riparian vegetation, armoring, relocating, straightening and confining stream channels and along tidal and estuarine shorelines influences the extent and magnitude of stream bank erosion and down cutting in the channel. In addition, these actions have reduced hydrological connectivity and availability of off-channel habitat and floodplain interaction. Armoring of shorelines to prevent erosion and maintain or create shoreline real estate simplifies habitats, reduces the amount of intertidal habitat, and affects nearshore processes and the ecology of a myriad of species (Williams and Thom 2001). As described in Amendment 18 in PFMC 2014, a river confined by adjacent development and/or flood control and erosion control structures can no longer move across the floodplain and support the natural processes that: 1) maintain floodplain connectivity and fish access that provide velocity refugia for juvenile salmon during high flows; 2) reduce flow velocities that reduce streambed erosion, channel incision, and spawning redd scour; 3) create side channels and off-channel areas that shelter rearing juvenile salmon; 4) allow fine sediment deposition on the floodplain and sediment sorting in the channel that enhance the substrate suitability for spawning salmon; 5) maintain riparian vegetation patterns that provide shade, large wood, and prey items to the channel; 6) provide the recruitment of large wood and spawning gravels to the channel; 7) create conditions that support hyporheic flow pathways that provide thermal refugia during low water periods; and 8) contribute to the nutrient regime and food web that support rearing and migrating juvenile salmon in the associated mainstem river channels. These activities are expected to adversely affect HAPCs for (1) complex channels and floodplains, and (2) thermal refugia.

2) Flood Control Maintenance – The proposed project will continue to prevent access to historic floodplain habitat by maintaining the levees constructed for flood protection. The protection of housing communities from flooding events can result in varying degrees of change in the physical, chemical, and biological characteristics of existing shoreline and riparian habitats. Maintaining the flood control levees results in the addition of rock armoring after any erosion event, regular (sometimes yearly) herbicide application, removal of riparian vegetation from the shoreline (also sometimes yearly), and other potentially harmful maintenance activities. Managing flood flows with flood control structures such as levees can disconnect a river from its floodplain eliminating off-channel habitat important for salmonids. Floodplains serve as a natural buffer to changes in water flow: retaining water during periods of higher flow and releasing it from the water table during reduced flows. These areas are typically well vegetated, lowering water temperatures, regulating nutrient flow and removing toxins. Juvenile salmon use these off-channel areas because their reduced flows, greater habitat complexity, increased food availability, and shelter from predators may increase growth rates and their chance of survival. Artificial flood control structures have similar effects on aquatic habitat as does the efforts to stabilize banks and remove woody debris. The function of natural stream channels and associated riparian areas and the effects of flood control structures such as levees has been discussed in section 2.4.1 of this opinion. The HAPCs adversely affected include (1) complex channels and floodplains, and (2) thermal refugia.

### 3.3. Essential Fish Habitat Conservation Recommendations

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

1) Bank Stabilization and Protection
    - Minimize the loss of riparian habitats as much as possible.
    - Bank erosion control should use vegetation methods or "soft" approaches (such as beach nourishment, vegetative planting, and placement of IWM) to shoreline modifications whenever feasible. Hard bank protection should be a last resort and the following options should be explored (tree revetments, stream flow deflectors, and vegetative riprap).
    - Re-vegetate sites to resemble the natural ecosystem community.
    - Replace in-stream fish habitat by providing root wads, deflector logs, boulders, rock weirs and by planting shaded riverine aquatic cover vegetation.
    - Use an adaptive management plan with ecological indicators to oversee monitoring and ensure mitigation objectives are met. Take corrective action as needed.
    - Minimize alteration of floodplains and wetlands in areas of salmon EFH.
    - Determine cumulative effects of all past and current floodplain and wetland alterations before planning activities that further alter wetlands and floodplains.
    - Promote awareness and use of the United States Department of Agriculture (USDA)'s wetland and conservation reserve programs to conserve and restore wetland and floodplain habitat.
    - Promote restoration of degraded floodplains and wetlands, including in part reconnecting rivers with their associated floodplains and wetlands and invasive species management.

2) Flood Control Maintenance
    - Retain trees and other shaded vegetation along the earthen levees and outside levee toe.
    - Ensure adequate inundation time for floodplain habitat that activates and enhances near-shore habitat for juvenile salmon.
    - Reconnect wetlands and floodplains to channel/tides.

Fully implementing these EFH conservation recommendations would protect, by avoiding or minimizing the adverse effects described in section 3.2, above, for Pacific Coast salmon HAPCs.

### 3.4. Statutory Response Requirement

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

### 3.5. Supplemental Consultation

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

## 4. Data Quality Act Documentation and Pre-Dissemination Review

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

### 4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the USACE. Other interested users could include DWR, SAFCA, USFWS, and CDFW. Individual copies of this opinion were provided to USACE. The document will be available within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

### 4.2. Integrity

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

### 4.3. 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 part 600.

***Best Available Information:*** This consultation and supporting documents use the best available information, as referenced in the References section. The analyses in this opinion and EFH consultation 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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