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

Refer to NMFS ECO #: WCR-2023-00509

August 31, 2023

Chandra Jenkins
Chief, 408 Permission Section
United States Army Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814-2922

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Tisdale Weir Rehabilitation and Fish Passage Project.

Dear Ms. Jenkins:

Thank you for your letter of August 12, 2022, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Tisdale Weir Rehabilitation and Fish Passage Project.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act [16 U.S.C. 1855(b)] for this action. NMFS' review concludes that the program will adversely affect the EFH of Pacific Coast Salmon in the action area, and has included conservation recommendations to minimize these effects.

Based on the best available scientific and commercial information, the enclosed biological opinion concludes that the Tisdale Weir Rehabilitation and Fish Passage Project is not likely to jeopardize the continued existence of the federally-listed 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 (DPS) of the North American green sturgeon (*Acipenser medirostris*), the threatened California Central Valley steelhead (*O. mykiss*) DPS, and is not likely to destroy or adversely modify their designated critical habitats. NMFS has also 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 proposed project.

Please contact Ally Bosworth in the NMFS California Central Valley Office via email at Allison.Bosworth@noaa.gov or via phone at (916) 930-5617 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 151422-2022-SA00037]

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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

Tisdale Weir Rehabilitation and Fish Passage Project

NMFS Consultation ECO Number: WCR 2023-000509

Action Agency: United States Army Corps of Engineers

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely To Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely To Destroy or Adversely Modify Critical Habitat?
Central Valley spring-run Chinook Salmon ESU (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
California Central Valley steelhead Distinct Population Segment (DPS (*O. mykiss*)	Threatened	Yes	No	Yes	No
Southern DPS of North American green sturgeon (*A. medirostris*)	Threatened	Yes	No	Yes	No
Sacramento River winter-run Chinook salmon ESU (*O. tshawytscha)*	Endangered	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: **August 31, 2023**

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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

- **November 6, 2018 -** Interagency Working Group (IWG) kick-off meeting. The California Department of Water Resources (DWR) convened a meeting to discuss the beginnings of a working team to design the Tisdale Weir Rehabilitation and Fish Passage Facility. The team consisted of members from United States Fish and Wildlife Service (USFWS), NMFS, United States Army Corps of Engineers (USACE), California Department of Fish and Wildlife (CDFW), the Central Valley Flood Protection Board (CVFPB), California State Lands Commission, and State/Regional Water Quality Control Boards. This team met multiple times between November 2018 and March 2019.

- **March 2019- May 2022 -** NMFS, DWR, and CDFW met multiple times and coordinated via email to ensure the fish passage was acceptable for both fisheries agencies.

- **August 12, 2022 -** NMFS received request for formal consultation from USACE.

- **August 25, 2022 -** NMFS sent request for more information regarding passage design, operations, and construction aspects.

- **November 11, 2022 -** NMFS considered the consultation withdrawn due to insufficient information.

- **November 2022-April 2023 -** DWR and NMFS met several times to discuss NMFS' request for more information.

- **April 18, 2023-** DWR and USACE submitted all requested information and formal consultation was initiated.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation and in an abundance of caution, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different.

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 will construct needed structural repairs to Tisdale Weir to extend the life of the structure and would modify the weir to add new on-site fish passage facilities (notch/channel/fish collection basin/baffles) to allow passage from behind the weir to the river to decrease the incidence of stranding. A secondary function of the proposed action increases the opportunities for volitional passage between the Sacramento River and Tisdale/Sutter bypasses during high flow events. Further, the redesign of the dissipation basin may improve fish rescue accessibility in the event a rescue is needed. The addition of baffle fishway elements will provide more suitable conditions for fish passage under a range of flow depths. Stranding of several fish species which are listed as threatened or endangered under either the California ESA or the Federal ESA is a primary concern being addressed by the action. Listed species present within the area include the 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 (DPS) of the North American green sturgeon (*Acipenser medirostris*), the threatened California Central Valley steelhead (*O. mykiss*) DPS, and their critical habitat.

The primary objectives of the project are:

- Structurally rehabilitate Tisdale Weir to extend its design life by an additional 50 years.
- Reduce fish stranding in the Tisdale Weir by improving fish passage through Tisdale Weir to the Sacramento River with minimal effects on facility maintenance and recreational access.

Existing Facilities

Tisdale Weir is an 1,150-foot-long, fixed-elevation, ungated overflow structure that was originally designed to overflow and convey up to 38,000 cubic feet per second (cfs) of excess Sacramento River floodwaters into the Tisdale Bypass, a 1,000-foot-wide, 4-mile-long channel that flows eastward to the Sutter Bypass.

The western boundary of the action area is the Sacramento River immediately west of the existing Tisdale Weir and the County's Tisdale Boat Launch Facility, which includes a two-lane launch ramp (32 feet wide and 152 feet long), a parking area slab (88 feet wide and 750 feet long, with 43 vehicle/trailer parking spaces), and an access road. The eastern boundary of the action area is downstream of Tisdale Weir and immediately east of the Garmire Road Bridge.

Cracking and other signs of damage to the concrete and rebar are present throughout the weir structure. Because of the structure's age and frequent use, it has sustained damage that, if not rehabilitated, could eventually result in the failure of the weir, with subsequent flooding, property damage, and possibly loss of lives. Rehabilitation of Tisdale Weir is intended to extend the weir's design life by an additional 50 years or more.

Need for the Project

This is a multi-benefit project intended to ensure that Tisdale Weir will continue to serve its authorized purpose as a flood risk reduction facility. The project was first envisioned in the 2012 Central Valley Flood Protection Plan (CVFPP), as an opportunity to integrate ecosystem restoration with an existing flood risk reduction project. Tisdale Weir is one of several locations within the Sacramento Flood Control system of weirs, bypasses, and other flood management facilities identified as a candidate for modification or rehabilitation to improve aquatic habitat and facilitate natural flow routing (DWR 2012).

As expressed in the 2012 CVFPP (DWR 2012): "DWR's goal in integrating ecosystem restoration and enhancement is to achieve overall habitat improvement, thereby reducing, or eliminating the need to mitigate for most ecosystem impacts."

The original purpose of the weir was for flood management, and the design materials and operations and maintenance manual do not indicate consideration for fish passage. Tisdale Weir is a barrier to fish passage during most flood events. The greatest chance for fish to move from the bypass to the river occurs when there are backwater conditions of sufficient depth in the Tisdale Bypass (greatly enhanced when downstream flows in the Sutter Bypass are elevated, causing the stage in the Tisdale Bypass to increase) and also when the Sacramento River stage is above the weir crest, allowing fish to potentially swim from the bypass into the river without a large hydraulic drop over the weir. During extremely large flood events, passage may be possible for a period of time near the flood peak for all fish species, if the weir and Tisdale Bypass are backwatered from the Sutter Bypass. Extensive hydraulic analysis confirms that Tisdale Weir is at times a barrier for Chinook salmon, steelhead, and green sturgeon (ESA 2019a).

After stranding events, fish rescues by CDFW have been conducted at Tisdale Weir to rescue juvenile and adult Chinook salmon, steelhead, and sturgeon from the weir's existing energy dissipation basin (DWR 2014; Beccio 2017; ESA 2019a). While trapped in the basin, fish are ultimately subject to lethal and sublethal conditions; if than overtopping event is the last weir spill of the season, their survival is dependent upon a timely fish rescue (i.e., removal and release).

1.3.1. Tisdale Weir Rehabilitation and Reconstruction

Rehabilitation and reconstruction of Tisdale Weir will address the weir's documented structural deficiencies. Some components will be rehabilitated by completing minor modifications to the existing structure and others will require demolition and full reconstruction. The weir crest will be repaired, and the two abutments (south and north) and the energy dissipation basin would be demolished and reconstructed. The project will permanently impact 1.66 acres and temporarily impact 1.23 acres of critical habitat. Additionally, there will be 0.46 acres of concrete that will be replaced.

The proposed reconstruction of the energy dissipation basin will be directly coupled with construction of the proposed fish passage facilities. More specifically, weir rehabilitation and reconstruction will involve the following steps:

- Remove and replace the southern abutment in kind and provide scour countermeasures (riprap, potentially with grout) around the reconstructed abutment.

- Remove and replace the northern abutment, which will incorporate an equipment pad to facilitate maintenance of the new connection channel and operable gate. The existing "Sacramento River at Tisdale Weir" water level (stage) gage in this vicinity will be removed and replaced with a new gage house structure.

- Fill in the depressed area between the existing gravel access road on the north side of the bypass and Garmire Road with engineered backfill material to construct a level area for the control building and equipment pad.

- Patch, resurface, and seal the existing concrete sill surface of the weir with a cementitious or epoxy material.

- Grout to fill potential voids beneath the existing weir structure.

- Partially demolish, remove, and reconstruct the existing energy dissipation basin with a basin that will serve an energy dissipation function and also incorporate improvements to fish passage and reduce the potential for fish stranding.

- Install provisions for monitoring equipment (*e.g.*, stage gages, cameras, telemetry antennae) in the weir and/or on abutments or adjacent banks.

- Investigate the integrity of the sheet pile wall through excavation and rehabilitate if necessary.

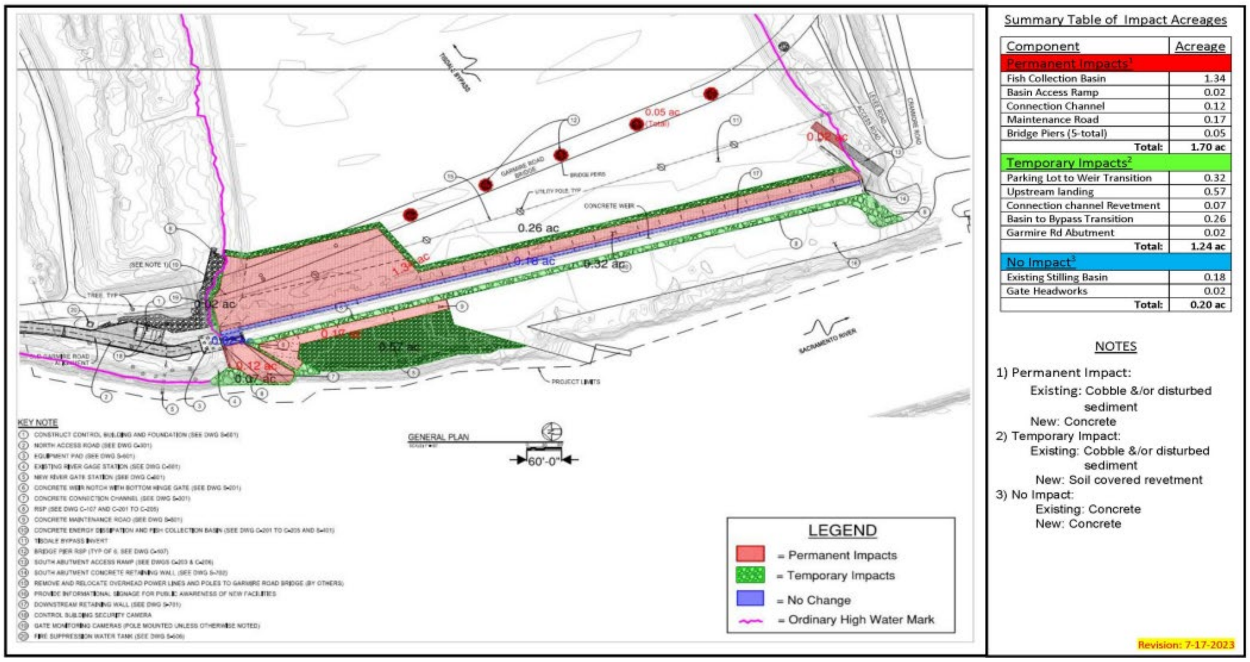

Figure 1. Map demonstrating expected temporary and permanent impacts to critical habitat

1.3.2. Installation of Fish Passage Facilities

The fish passage facilities constructed for the project will include reconstruction of an integrated energy dissipation to include a fish collection basin on the downstream side of the weir; installation of a notch, an operable gate (for flow regulation), and attendant facilities at the north end of the weir; construction of a channel connecting the notch in the weir to the Sacramento River; and installation of "EL" baffle fishway elements inside the connecting channel (see example below in figure 2). The fishway was designed in conjunction with NMFS and CDFW biologists and engineers using NMFS 2011 Fish Passage Guidelines as criteria.

Discovery Drive prototype corner "EL" baffle fishway on University Creek
(Source: Ross Kapitzke)

Corner "EL" baffle fishway installed in culvert – looking downstream (15/12/05) | **Corner "EL" baffle fishway in low flow conditions – looking downstream (11/04/06)**

Figure 2. Example of an "EL" style baffle in a fishway

Fish Passage Criteria

The fish passage facilities are intended to provide passage for all species; however, the designs focus on salmonids and green sturgeon. The facilities are designed to maximize the frequency and duration of events capable of meeting fish passage criteria for Chinook salmon and green sturgeon migrating upstream from the Tisdale Bypass to the Sacramento River after river flows have overtopped the weir and spilled into the bypass. During an overtopping event and after for several days to several weeks or longer the facilities' gate would be kept open to maintain a connection between the bypass and the river.

Operation of the notch to facilitate fish passage involves opening the gate upon Sacramento River stage overtopping the weir crest (44.1 feet NAVD88) and keeping the gate open until Sacramento River stage drops below the invert of the notch and fish basin (33 feet) to allow fish to return to the river. However, due to the presence of a downstream topographic high point (or "hinge" point) in the Tisdale Bypass (about 1,500 feet downstream of the weir), flow down the bypass ceases when the water surface elevation at the weir drops below approximately 37 feet.

Energy Dissipation and Fish Collection Basin

A multi-purpose concrete or roller-compacted concrete energy dissipation and fish collection basin (basin) would be constructed on the downstream side of Tisdale Weir, occupying approximately 2 acres from the weir downstream. The existing energy dissipation basin on the downstream side of the weir will be removed and replaced to provide necessary energy dissipation, reduce fish stranding, support fish passage to the notch, and improve operational flexibility for maintenance and, if necessary, any fish rescues.

The proposed basin will dissipate hydraulic energy when the Sacramento River spills over the weir or through the notch. The basin will also be configured to provide a transition and pathway for migrating fish that could be efficiently maintained (*e.g.*, cleared of debris and sediment). The basin will be designed so that when water from the Sacramento River was no longer flowing into the basin, the pool area would recede (drain) concurrent with the recession of the river, the hydrologic signal of which would encourage fish to move from the basin to the river (*i.e.*, toward deeper water).

The basin will extend eastward from the weir. Based on existing observations relative to the design, annual sediment accumulation will occur out into the bypass and on the downstream end of the basin, forming a low-flow channel directly adjacent to the weir and along the basin's axis (from roughly south to north) with a width of approximately 25–60 feet. To counter higher flow velocities through the notch, scour protection measures will be incorporated along the trailing (downstream) edge of the basin; at and between the bridge piers; at the southern transition from the basin to the bypass; and farther into the bypass at the northern end downstream of the notch. Scour countermeasures will consist of riprap or alternative forms of armoring.

The basin will slope up from the notch (elevation of 33 feet) at the north to the transition to the bypass invert at the south (elevation of approximately 36 feet at the top of the basin). The slope will place deeper water at the notch and shallower water at the far southern end of the basin.

This configuration will allow water to recede from south to north toward the notch as floodwaters decline. This "drainage" configuration, and the presence of deeper water at the notch end of the basin, will help to entice any remaining fish to exit by swimming through the notch as the Sacramento River stage recedes. The hinge point about 1,500 feet downstream of the weir and at an elevation of approximately 37 feet is a factor in how the basin stays ponded and drains; the hinge point is anticipated to remain at a similar elevation with the project.

Permanent scour and erosion countermeasures will be included on the north end of the basin. The concrete footprint of the basin will extend downstream of Garmire Road in the form of an apron to address the higher velocity flows passing through the notch. Further, riprap or engineered concrete energy dissipaters will be placed along the northern bank of the bypass just downstream of the proposed notch for scour protection, and limited grading would be implemented to prepare the subgrade and facilitate rock placement.

Weir Notch and Operable Gate

A notch (*i.e.*, the fish passage structure) will be installed in the north end of Tisdale Weir to provide a connection between the Tisdale Bypass (and basin) and the Sacramento River, via a connection channel. The concrete, rectangular notch opening would be just over 11 feet tall by approximately 33 feet wide, and the invert (or bottom) of the notch would be at an elevation of 33 feet. With the gate open, when the water surface elevation of the Sacramento River is at or above this level, a connection could be made between the river and the area downstream of the Tisdale Weir, with flow down the bypass controlled by the hinge point and river stage.

The notch opening will be controlled by a pneumatically actuated, bottom-hinged gate that would span the notch. To raise or lower this type of gate, an air bladder is inflated or deflated, respectively. The dimensions, location, and orientation of the notch and connection channel are designed to maximize the range of flows over which fish could successfully move from the bypass to the river when the gate is open. The water (west) side of the gate would be fitted with a smooth cover plate to reduce the potential for any green sturgeon injuries.

The connection channel will provide a route connecting the notch in the weir to the Sacramento

River for fish passage. The connection channel will be excavated and constructed within the east bank of the Sacramento River and tied in to the rectangular, 33-foot-wide by 11-foot-tall concrete notch opening. From this tie-in point west (upstream) to the Sacramento River, the connection channel will be angled south (downstream) at approximately 45 degrees. The channel will be approximately 130 feet long, with bottom widths of 32 feet at the downstream end (outlet to the Tisdale Bypass) and approximately 27 feet at the upstream end (inlet from the Sacramento River). The side slopes of the connection channel will transition from 2:1 at the Sacramento River end to vertical at the end where the connection channel would tie into the notch. The bottom of the channel will start at the Sacramento River with an invert elevation of 32.5 feet and would slope upward before terminating at the notch at an elevation of 33 feet. This configuration is modeled to meet the fish passage criteria listed in Table 3-1 for a large range of flows, greatly improving fish passage during and after weir overtopping events.

"EL" baffle design elements will be installed along the bottom edges inside of the channel, as described further below. Baffles will be arranged 16 feet apart with staggered 8-foot embedded plates on both walls of the channel. Adaptive management will be implemented to determine the final configuration and spacing of baffles to optimize performance. The baffles themselves will be 3-feet high in consideration of green sturgeon and 4-feet wide for tail motion. These re-arrangeable baffles will be placed to mostly benefit green sturgeon by providing a sheltered area of localized flow patterns to assist upstream passage. They can be moved depending on management needs.

The slope and configuration of the connection channel and its relationship to the basin will provide continuity and inundation between the Sacramento River and the basin as the river recedes and stops flowing into the bypass (instead remaining backwatered in the basin behind the weir). The slope from the top of the basin to the connection channel at the river will place the deeper water at the notch and the connection channel, and thus will encourage fish to swim from the basin into the river. As the river stage decreases, the inundation area will gradually recede back toward the river, and the water will be deeper in the parts of the basin/connection channel closer to the river. These conditions will provide an incentive for fish to find these areas and pass to the river.

Riprap will be placed at the inlet to the proposed connection channel in the Sacramento River to prevent scour at the inlet. If required because of river stage levels, a cofferdam may be used during construction to isolate the site for the connection channel from the Sacramento River. Installation of the cofferdam will be phased to avoid and minimize potential stranding. All pumps used during the dewatering will meet approved screening criteria. A dewatering and fish rescue plan will be submitted to NMFS for approval prior to construction. The connection channel will be excavated to an average depth of 12 feet below the existing grade and will be constructed with scour resistant materials such as concrete. The bed will consist of concrete.

Baffle Fishway Elements

"EL" baffle fishway elements will be installed along the inside walls of the connecting channel. A baffle is a hybrid roughness element that is intended to provide suitable conditions for fish passage under a range of flow depths, including withstanding major variations in upstream water level and velocity. The corner "EL" baffle design provides localized shelter areas and flow recirculation within the baffle field that support the movement of fish in a burst and rest pattern through the connection channel. “EL” shaped baffles are placed perpendicular to the connection channel wall, protrude a short distance from the wall, then extend up the wall from the culvert floor.

The corner “EL” baffle elements provide flow retardation, shelter behind baffles, and some recirculation within baffle sets, with free-flowing conditions retained on the other open side of the fishway (Kapitzke 2010). The baffle arrangement provides a zone of flow resistance adjacent to the channel wall and shelter areas within the baffle field to assist upstream fish movement. Sheltered flow conditions provide enhanced conditions for upstream fish movement between baffle sets.

Velocities around the streamside end of the horizontal baffle leg in the lower flow layer and the streamside end of the vertical baffle leg in the upper flow layers are less than velocities in the open channel section opposite to the baffles. Unrestricted flow in the open channel section of the connecting channel opposite to the corner “EL” baffle improves attraction flow for fish into the corner “EL” baffle fishway culvert, and locally accelerated flow around the streamside end of the baffles provides attraction flow for fish to move upstream.

The standard configuration for the corner “EL” baffle fishway has perpendicular baffles at 90 degrees to the side of the channel. Baffle size, locations, and spacing can be accommodated within the channel through the use of different plates embedded in the concrete. Adaptations of the corner “EL” baffle fishway design can include tilting the baffles from the horizontal plane and angling the baffles to the vertical plane. A sloping upstream face may assist to shed debris from the baffles if a tendency develops for trapping large woody debris.

Entrance Road, Equipment Pad, and Control Building

Modifications at the north end of Tisdale Weir will include construction of an entrance road, equipment pad, and control building for monitoring, operations, and maintenance purposes.

The existing entrance road (*i.e.*, relocated Garmire Road) will be constructed or improved to provide access for the transport of large equipment (*e.g.*, an excavator), and for other vehicles requiring access to the equipment pad and control building area at the north abutment.

An existing access to the Tisdale Bypass, located approximately 400 feet to the east of the north abutment, will be improved to provide large vehicle access during the construction period and will be returned to existing conditions upon completion.

An equipment pad will be constructed adjacent to the reconstructed northern abutment and will facilitate northern access for any necessary gate repair, replacement, or maintenance, and access to the notch by emergency equipment (*e.g.*, to remove debris and maintain the gate).

Access for maintenance of the connection channel and/or gate could also be provided by the access road in front of the weir via the boat launch parking lot. The equipment pad will consist of a reinforced concrete platform measuring approximately 50 feet by 50 feet, supported on grade or on a deep pile foundation. Compacted aggregate gravel and asphalt will be installed surrounding the building, equipment pad, and vehicular access road. The existing gravel vehicular access road between Garmire Road and the north abutment will be repaired with additional gravel or replaced with asphalt paving as necessary to support access by heavy equipment and to reduce maintenance at the facility.

An approximately 30-foot by 30-foot control building will be constructed at the north end of the weir. The control building will house communication, electrical, mechanical, and monitoring equipment components related primarily to operation and monitoring of the gate, stage gaging, and other monitoring. The building will be enclosed by security fencing to protect the building and associated components. A concrete-encased duct bank will connect all electrical, air lines, and controls from the building to the operable gate and/or notch.

1.3.3. Construction Schedule and Site Activities

Project construction is anticipated to begin in April 2024 and has the potential to last up to two consecutive construction seasons, each approximately 6½ months long (April 30 through October 31). The timing of construction is subject to the availability of project funding; any delays in funding may extend this timeline by 2–3 years.

In-water construction activities, including cofferdam construction (sheet pile installation) and dewatering, will be restricted to July 1 to September 30, when listed fish species are less likely to occur within or near the project site. If in-water work can be avoided during cofferdam installation because the river is low enough that cofferdam installation occurs on dry land, outside of the water, then cofferdam construction may start as early as April 30. Work will be suspended if Tisdale Weir is forecast to overtop during the construction window.

Construction will typically occur Monday through Friday, up to 12 hours per day between 6 a.m. and 7 p.m. However, construction work may be extended into the night or weekend if needed to meet critical milestones, or at other key points in the construction process. Adjacent landowners and the County will be notified before the start of construction activities.

Site Preparation and Equipment

Water trucks will be used for dust control in the action area and along haul routes. Surface water from the Sacramento River or adjacent canals will be used for dust control; the contractor will make prior arrangements with the reclamation districts or adjacent landowners and appropriately sized intake screens will be used. Table 3-2 lists the construction equipment that will likely be required to construct the project. Duration assumes a worst-case scenario of two 150-day construction windows, working 7 days a week during those work windows.

Table 3-2: Anticipated Construction Equipment

Type of Equipment	Number of Equipment	Average Use (per day/duration)
Excavator	2	12 hours/300 days
Crane	2	12 hours/300 days
Grader and roller	3	12 hours/300 days
Bulldozer	3	12 hours/300 days

Tractor/loader/backhoe	3	12 hours/300 days
Water truck	4	12 hours/300 days
Other equipment (e.g., chain saw)	1	12 hours/300 days
Compressor	6	12 hours/300 days
Generator	5	12 hours/300 days
Dewatering pump	5	12 hours/300 days
Concrete mixing truck	5	12 hours/300 days
Concrete pumping truck	2	12 hours/300 days
Concrete batch plant	1	12 hours/300 days
Forklift	2	12 hours/300 days
Dump/haul truck	4	12 hours/300 days
Grout plant	1	12 hours/300 days
Rock truck (for concrete)	1	12 hours/300 days
Pickup truck	2	12 hours/300 days

A concrete batch plant may be used on-site to facilitate concrete mixing and production. If needed, the concrete batch plant will be located in the southernmost staging area (1.5 acres) and produce the 10,500 cubic yards of concrete supply estimated to be needed for the project. Existing roads and the proposed access ramp will be used to transport material from the batch plant to the basin in 10-yard batches in mixer trucks. Up to 800 total truck trips will be needed to deliver materials from the supplier to the batch plant stockpile, with a maximum of 32 trips per day transferring approximately 400 cubic yards of concrete material to the project site for a total of 66 concrete pour days (150 cubic yards per day average).

The project is anticipated to require up to 34 construction workers. Workers will access the action area daily from the south via State Route 113 north to Reclamation Road, or from the north via State Route 20 to Tarke Road to Garmire Road or Reclamation Road. Worker vehicles will be parked in the staging areas or on the levee road where the levee is close to the construction footprint.

Construction trucks would be parked in one of the designated staging areas or within the Tisdale Bypass during work hours. Contractor fuel storage will be isolated to the southernmost staging area outside of in-water areas, and fueling will occur within the bypass with the implementation of best management practices (BMPs).

As necessary, excavated material will be temporarily stockpiled in one or more of the following staging areas:

- Adjacent to the immediate work area inside the Tisdale Bypass;
- The current parking area/turnout at the north end of the weir;
- The open area just north of the paved parking lot/boat launch facility
- The adjacent Sutter Mutual Water Company maintenance yard

If needed, borrow material would come from Tisdale Bypass excavation areas inside this project's work area, or imported/engineered fill would be hauled onto the site from an external source. Staging areas and the construction footprint will be cleared and grubbed before construction.

Spoils will be placed and spread on an existing spoils placement location, a currently fallow field of approximately 82 acres owned by the State of California, located approximately 1.5 miles east of the project site. All disturbed dirt will receive hydroseed at completion of the project. The haul route to the spoils area will be along the Tisdale Bypass north levee road or Garmire Road east of the project site to Tisdale Road to Reclamation Road. Up to 330 cubic yards of soil per day could be hauled to the spoils storage area, generating up to 33 truck trips per day based on a capacity of 10 cubic yards each (over a duration of approximately 110 days, based on estimated excavation volumes). All concrete, steel, and demolition debris will be hauled away and disposed of in an approved disposal facility by the contractor.

Portions of the eastern edge of the parking lot for the Tisdale Boat Launch Facility may be blocked off to public access during construction, which will be coordinated with the County. Construction workers will manage the flow of vehicles maneuvering in and out of the parking lot. The boat ramp, which is operated by the County, is anticipated to remain open during project construction.

The construction area will be clearly marked with fencing and security measures will be implemented to protect the project site and equipment. Security measures will include security-grade fencing and nighttime lighting for areas within the project site (*e.g.*, staging locations with equipment and/or materials, possible concrete batch plant).

Weir Rehabilitation and Reconstruction

Rehabilitation of the weir's south abutment would involve excavating and removing the existing concrete abutment structure (approximately 900 cubic yards) and constructing a new, similar abutment structure in its place. Surrounding the new south abutment structure, approximately 300 cubic yards of riprap will be placed for scour protection at a thickness of approximately 3 feet.

Rehabilitation of the north abutment will involve excavating and removing the existing concrete abutment structure (approximately 800 cubic yards) and constructing a new, similar abutment structure in its place. The gravel paving for vehicular access to the abutment will be replaced or stabilized with asphalt paving, and a reinforced concrete pad for equipment (crane) access will be constructed. The equipment pad may be partially supported on grade and may also be supported on a deep pile foundation. To construct level support areas, fill and grading for the control building pad will extend into the small depression between the existing northern access road and Garmire Road; fill and grading for the equipment pad will extend south of the existing northern access road toward the weir. Filling and grading will include maintaining a sloped, surface drainage path in the depressed area between the existing gravel access road and Garmire Road. Surrounding the new north abutment structure, and extending east along the north bank, approximately 450 cubic yards of riprap will be placed for scour protection at a thickness of approximately 3 feet.

To rehabilitate the weir's foundation through a grouting operation, drilling and grout pumping equipment will be used along the crest to fill the voids in the soil beneath the structure. The weir will also be high-pressure blasted (using a sand, glass, or water blasting medium or surface grinding) to remove the surface layer to prepare for resurfacing. The weir will be capped with a cementitious or epoxy-based material to increase durability over the next 50 years.

The entire connection channel, notch and collection basin will be concrete with the express intent to provide the most durable and maintainable surface that is not injurious to fish. In areas that transition to riprap, the transition will be constructed to avoid rough surfaces as well as to fill any voids. Most of the revetment will be soil covered through the natural deposition of sediment. This can be monitored through the operations monitoring plan and adjustments made as necessary.

Installation of Fish Passage Facilities

Constructing the fish passage facilities will involve the following steps:

- Improve or reconstruct the northern access road on the north side of the weir from Garmire Road to the north abutment (*i.e.*, the entrance road to the location of the equipment pad and control building).

- Construct an equipment pad immediately above and north of the north abutment face to allow equipment access to this area from Garmire Road and to facilitate gate maintenance.

- Fill and grade the small depression between the existing northern access road and Garmire Road for the equipment pad; fill and grading for the equipment pad will extend south of the existing northern access road toward the weir.

- Construct a control building to house electrical, mechanical, and communication equipment for the operable gate and potential monitoring equipment.

- Install site utilities (*i.e.*, power and communication) on the north end of the weir to support the operable gate.

- Install scour countermeasures (*e.g.*, riprap or grout) that would extend from the north abutment into the bypass channel, to provide scour protection from the higher water velocities that would come through the connection channel under certain flow conditions.

- Remove a portion of Tisdale Weir and install a concrete notch structure within the existing weir, approximately 11 feet tall by 33 feet wide, to facilitate fish passage and accommodate the operable gate. The side slopes of the notch will be vertical.

- Construct an approximately 27-foot- to 33-foot-wide by 11-foot-deep connection channel from the Sacramento River to the proposed notch, terminating in the proposed fish collection basin. The channel will have side slopes of approximately 2:1 at the Sacramento River, steepening to vertical at the location of the gate. The channel will be constructed with concrete to prevent scour and facilitate fish passage and drainage of the basin. In addition, sub-angular riprap may be installed adjacent to the channel to resist scour.

- Install “EL” baffle design elements within the new connection channel from the Sacramento River to the proposed notch.

- Install an operable, bottom-hinged gate in the notch, including utility connections for electrical, mechanical, and controls. The gate will likely be composed of two 16.5- foot-wide by 11-foot-high gate panels, assembled together with an individual air bladder under each panel for raising and lowering the gate. The two separate panels will be assembled together to form a single gate, and thus will be opened and closed together (rather than independently) to minimize structural support requirements, minimize debris impingement, and optimize fish passage performance.

- Excavate soil to construct a concrete basin across the downstream edge of the entire weir. Adjacent scour countermeasures (*e.g.*, riprap or rounded material) will provide a transition from the basin to native ground. The basin will be sloped to the notch to allow water to drain to the notch, to minimize fish stranding.

- On the south side/downstream edge of the basin, fill and smooth undulating topography and install scour countermeasures (*e.g.*, riprap, rounded material, or grout) to provide a transition to native ground and drainage to the notch to minimize fish stranding.

- On the north side/downstream edge of the basin (apron), excavate soil, remove vegetation (including trees), extend and elevate the concrete basin farther downstream, and installing adjacent riprap or grout as a scour countermeasure for the higher water velocities through the notch. This feature will provide scour protection, weir energy dissipation functions, a transition to native ground, and drainage into the basin when the operable gate is open, to minimize fish stranding.

- Install a basin access ramp on the south side of the bypass, likely using riprap and aggregate base for erosion protection. The ramp will provide access into the basin and bypass from the existing levee road to facilitate maintenance activities.

- Install security cameras; electronic instruments that provide depth, temperature, and dissolved oxygen readings at regular intervals; and infrastructure required to accommodate installation of an ARIS-type (adaptive resolution imaging sonar)camera to facilitate green sturgeon monitoring (see Fish Monitoring Plan)

Construction of the Energy Dissipation and Fish Collection Basin

Construction of the concrete energy dissipation and fish collection basin will disturb approximately 2 acres of critical habitat. Constructing this project component will require excavating approximately 16,500 cubic yards of native soil and the existing concrete energy dissipation basin at an average depth of 4 feet. Up to approximately half of this volume may be used to fill areas of over-excavation and/or complete the finished grade along the eastern (downstream) side of the basin, which would reduce the volume of material to be placed in the spoils storage area.

The proposed basin will be composed of concrete and base rock with a total thickness of approximately 3 feet. Construction will result in the placement of approximately 29,000 cubic yards of gravel and concrete, riprap, cobble, and/or engineered streambed material. The basin would also provide scour protection for the Garmire Road Bridge piers. The basin is founded with helical tension piles designed to counterbalance the uplift pressure exerted up through the ground by water seepage forces. The piles are spaced at a maximum of 10 feet on center covering the entire dissipation basin area. Approximately 614 helical piles are planned to be installed. The closest pile will be located about 105 ft from Sacramento River. Helical piles are like giant screws that are installed using a powered torque motor mounted to standard construction equipment providing continuous torque that advances the helical pile into the soil. In addition, a basin access ramp will be constructed on the south side, extending from the levee road to the basin/bypass bottom. This will require regrading up to approximately 250 feet of the existing access ramp near the levee and result in the placement of up to approximately 200 cubic yards of riprap and aggregate base for stability and paving on the access ramp.

Although such a scenario is not anticipated, should water be present in the bypass at the start of construction, a fish rescue and dewatering operation with approved screening on pump intakes will be conducted. Pump discharge will comply with approved BMPs. After the initial dewatering, maintenance dewatering would be completed to keep the site dry. Water from dewatering operations will be discharged directly into the bypass and turbidity will be monitored as appropriate (*i.e.*, the discharged water will likely percolate into the bed of the bypass). Equipment working below the ordinary high-water mark (OHWM) will be cleaned to prevent the spread of invasive species. USACE defines the OHWM as "the line on the shore established by the fluctuation of water, indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas." While water is not anticipated to enter the bypass during construction, DWR is in constant contact with the Central Valley Flood Protection Board (CVFPB) concerning flooding and possible weir overtopping. Construction will not continue into the flood season unless authorization is provided by the CVFPB.

Construction of the Weir Notch and Operable Gate

Construction of the weir notch and operable gate will require excavating approximately 30 cubic yards of existing concrete and native soil to a depth of approximately 12 feet. Construction may also require installing piles and/or a sheet pile cutoff wall. The existing concrete weir structure will be saw-cut to allow clean excavation of the notch.

The notch will be constructed of concrete and base rock with a total thickness of approximately 4.5 feet. Construction will result in the placement of approximately 30 cubic yards of concrete and gravel. Construction will also include installation of the operable bottom-hinged gate and the associated mechanical and electrical equipment. The foundation design of the gate notch structure and north abutment walls include installation of a deep pile foundation with additional soil improvements to support the structures. The steel piles are hollow 14" steel pipes and are estimated to be driven to an approximate depth of 40 to 60 feet below ground surface (pending additional geotechnical data to confirm required depth). There are a total of approximately 70 piles that support the gate structure and north abutment walls. In addition to the deep piles, soil improvement techniques including vibratory stone columns will be used to densify and strengthen the soil in the vicinity of the deep piles. This method will utilize a vibratory poker to create a void space that is then filled with graded stone aggregate, which is then compacted into the surrounding soils. The effect produces improvements in the density of the ground and bearing capacity and settlement characteristics of the soils. Ground improvement techniques contain no added cement, concrete, or steel. All the piles and soil improvements will be installed on dry land.

Construction of the connection channel will disturb approximately 0.5 acre. The construction will require excavating approximately 3,300 cubic yards of native and fill soils at a depth of approximately 12 feet. The channel will be constructed of concrete and base rock with a thickness of approximately 3 feet. Construction will result in the placement of approximately 800 cubic yards of concrete and gravel. Scour protection surrounding the connection channel will result in the placement of approximately 300 cubic yards of riprap at a thickness of 3 feet.

Construction of the connection channel may require in-water work and isolation of the work area from the Sacramento River. In this case, a cofferdam may be constructed to isolate the work area from the river if required, based on water elevations during construction. The cofferdam will consist of sheet piles installed through either vibratory or impact driving. The sheet piles will be installed by land-based heavy equipment located on the bank north of the boat launch facility.

This temporary work area will be revegetated with hydroseed and/or covered with rock revetment per the project design. Before construction, fish rescue and dewatering with approved screening will be conducted. During dewatering, water will be pumped into the dry Tisdale Bypass, to avoid any additional suspended sediment being placed into the Sacramento River.

Construction of the Entrance Road, Equipment Pad, and Control Building

Modifications at the north end of the weir will include construction of an entrance road, equipment pad, and control building for monitoring, operations, and maintenance purposes. An entrance road will be constructed or improved to provide access for the transport of large equipment (*e.g.*, an excavator), and for other vehicles requiring access to the equipment pad and control building area at the north abutment.

An equipment pad will be constructed adjacent to the reconstructed northern abutment and will facilitate northern access for any necessary gate repair, replacement, or maintenance, and access to the notch by emergency equipment (*e.g.*, to remove debris and maintain the gate). Access for maintenance of the connection channel and/or gate may also be provided by the access road in front of the weir via the boat launch parking lot. The equipment pad will consist of a reinforced concrete platform measuring approximately 50 feet by 50 feet, supported on grade or on a deep pile foundation. Compacted aggregate gravel and asphalt will be installed surrounding the building, equipment pad, and vehicular access road. The existing gravel vehicular access road between Garmire Road and the north abutment will be repaired with additional gravel or replaced with asphalt paving as necessary to support access by heavy equipment and to reduce maintenance at the facility.

An approximately 30-foot by 30-foot control building will be constructed at the north end of the weir. The control building will house communication, electrical, mechanical, and monitoring equipment components related primarily to operation and monitoring of the gate, stage gaging, and other monitoring. The building will be enclosed by security fencing to protect the building and associated components. A concrete-encased duct bank will connect all electrical, air lines, and controls from the building to the operable gate and/or notch.

Construction of Project Site Improvements

Existing utility poles (power and communication) within the footprint of the proposed basin will be removed and relocated to the Garmire Road Bridge in existing utility openings that were installed during construction of the bridge or attached to the outside of the bridge. This activity will be coordinated with the County and will include obtaining all necessary County approvals and permits.

Site improvements would also include filling and protecting some existing areas around the weir. Undulating topography north of the boat launch parking lot and south of the north abutment will be filled and smoothed with scour resistant materials (riprap or articulated block mat) and the area would be regraded to a smooth character. Further, the existing cobble along the leading (upstream) edge of the weir will be stabilized by adding material, compacting, and/or grouting.

Scour countermeasures will be installed around the Garmire Road Bridge piers. The countermeasures will be concrete in areas where the basin's footprint will extend to or beyond (downstream of) the bridge piers. However, riprap will also be used as needed if concrete is not installed up to the bridge pier(s). The necessary level of scour protection at each pier would be determined through an analysis of hydraulics and scour countermeasures.

1.3.4. Operations and Maintenance

DWR is responsible for operating and maintaining Tisdale Weir and will take on new responsibilities to operate and maintain the proposed fish passage facilities. Personnel from DWR's Flood Maintenance and Operations Branch routinely inspect and evaluate conditions at flood risk reduction facilities to identify areas where maintenance is needed. Accumulated sediment and vegetation or other debris, along with improperly functioning structures, can reduce channel capacity; deflect, divert, and inhibit flows; cause bank and levee erosion; or increase the risk of levee overtopping and failure. Proper operation and maintenance of the proposed fish passage facilities are important to ensuring that the facilities can continuously enable fish to pass back into the Sacramento River during flood flows and when floodwaters recede lower than the weir crest.

Gate Operations

The proposed basin, notch, and connection channel will function collectively to provide fish passage from the Tisdale Bypass to the Sacramento River. The notch and operable gate will control the frequency and duration of fish passage between the bypass (and basin) and the river via the connection channel. With the gate open, when the water surface elevation of the Sacramento River is at or above the notch invert elevation, a wetted connection could be made between the river and the Tisdale Bypass.

The notch will incorporate a bottom-hinged gate to allow the structure to be opened and closed as necessary for flow control, maintenance, repairs, or any other reason at any time. The notch will operate in conjunction with any Tisdale Weir overtopping event, regardless of season or time of year. During the dry season (after April 30), when overtopping is unlikely and the Sacramento River's water surface elevation is below the notch invert elevation, the gate will be stored in the down position to reduce the risk of vandalism to the air bladders on the back/bypass side of the gate, and to reduce the energy needed to keep the bladders inflated. The gate will typically be moved to the up (closed) position at the onset of flood season (November 1). If warranted by rainfall or weather forecasts indicating a potential rise in the river, or if otherwise deemed appropriate by DWR, the gate may be moved to the up position before November 1 or after April 30.

In general, during the flood season (November 1 to April 30), the notch gate will be in the up (closed) position, but will be opened shortly after a Tisdale Weir overtopping event (*e.g.*, within approximately 4 hours of the onset of flow into the Tisdale Bypass). The notch gate will be closed once the Sacramento River stage recedes below the notch invert elevation and water has drained from the basin. However, the Sacramento River hydrograph can be highly variable, even over relatively short time periods (days); thus, a slightly more detailed outline of the proposed gate operations is provided below. Note, however, that the plan for gate operations may change or evolve somewhat based on further agency input or longer-term adaptive management actions, or both.

Normal Operations

1. Operating the notch gate to facilitate fish passage will involve opening the gate soon after the Sacramento River stage overtops the weir crest (44.1 feet) and keeping the gate open until the river stage drops below the invert of the notch and fish basin (33 feet) to allow fish to return to the river. To provide time for the bypass to become inundated, the gate will be set to open automatically approximately 4 hours after the Sacramento River stage overtops the weir crest. Without this delay, opening the gate would allow water approximately 11 feet deep to flow into the bypass without any backwater present, which would not be helpful for reducing scouring forces. Further, without flow in the Tisdale Bypass, no fish would be present at the weir until the bypass is inundated and fish swim upstream to the weir.

2. If the gate were initially closed and (1) the weir was not being overtopped or (2) the Sacramento River discharge shortly after weir overtopping was exceeding or projected to exceed 48,000 cfs—the 10-year design flow—the gate will remain closed. Pending the USACE section 408 permitting process, the current assumption is that the project will not be permitted to alter the flow split at this location (the proportion of flow in the Sacramento River that overtops the weir) during flood conditions. Therefore, the gate would need to be closed once flow in the Sacramento River exceeds a 10-year flood event.

3. If the Sacramento River reached, or was projected to soon reach, approximately 48,000 cfs, the gate will be closed (if it had been in the open position). The gate will be opened again once the river's flow recedes below 48,000 cfs.

4. If the Sacramento River were to fall below a stage of 33 feet, the gate will be closed and would remain closed until the next weir overtopping event.

In some cases, it may be necessary to deviate from or modify normal operations. Some specific, potential variations from normal operations are described in further detail below.

Operations during Brief Overtopping Events

Should an overtopping event (OE) be very short or minor (*e.g.*, lasting for less than 4 hours), the Tisdale Bypass would be only briefly and/or barely inundated. Under such conditions, fish migrating from the Sutter Bypass may be unlikely to navigate the full length of the Tisdale Bypass and successfully pass through the fish passage facility. Thus, operating the notch gate during brief or minor flow events—even with the intention to enable fish passage—may actually be counterproductive. For example, in such an instance, the additional flow through the notch could be enough to attract fish to the Tisdale Bypass from downstream areas; yet if the Sacramento River stage were to subsequently drop rapidly, these fish may not have sufficient time to move completely through the Tisdale Bypass and into the river. As a result, opening the notch gate under these conditions could function as a sort of "attractive nuisance" that may increase the risk of stranding downstream in the Tisdale Bypass.

An inundation event will be defined by a flow that equals or exceeds 38,000 cfs or a stage level equivalent to approximately 44.1 feet North American Vertical Datum (NAVD).

Modeling suggests that a flow of 43,623 cfs equates to approximately a 2-year flood event and would result in a flow of 1,590 cfs through the Tisdale Weir notch. OEs will be monitored by two KPSI level and pressure transducers, to be installed during construction, on the north abutment wall, five feet upstream and downstream of the weir crest. These transducers will help predict OEs and the need for gate opening of the Tisdale Weir. Reports from the transducers will go through an internal supervisory control and data acquisition system, and the data will be available on the California Data Exchange Center (CDEC) to the public. This data will likely be recorded at least every hour. DWR will be monitoring this data closely in anticipation of OEs. There is also a current CDEC gauge at Tisdale on the Sacramento River that records OEs as well, that will remain in place. This existing gauge will be updated to also record Sacramento River elevations, as a second source of data.

DWR will monitor these events for 5 flood years (see fish monitoring plan section) to determine if proposed operations is meeting the success criteria to reduce fish stranding. CDFW, NMFS, and DWR will form a technical working group (TWG) and work together to consider ways that DWR might adaptively manage this aspect of operations over the life of the project. The TWG will determine the relative risk to migratory fish for these minor overtopping events and recommend the minimum flow and/or duration of spill below which the notch would not be opened. The TWG will recommend these criteria and could revise these criteria based on monitoring and adaptive management, as described in the adaptive management conservation measure.

Early Closure of the Gate

If for any reason DWR needs to close the gate early, before the Sacramento River recedes below the invert elevation of the notch, the gate would be closed slowly to ramp down notch flows over an extended period (for example, 24 hours, allowing a hydrologic queue for fish to pass to the river). As the Sacramento River stage recedes following gate closure, the gate will be opened again when river stage goes below the 37-foot hinge point. This will allow fish to exit into the Sacramento River. The gate closure approach and criteria will be refined and finalized based on agency input. It should be noted that this contingent operation may not be necessary.

Gate Failure

Certain anthropogenic and/or natural, stochastic processes may temporarily affect and alter connectivity and/or hydraulics within the notch, connection channel, or basin. For example, mechanical or electrical failure or a debris/sediment blockage could prevent the gate from opening. In such a case, the notch may not open at all, or flow velocities through a partially open notch may be increased (relative to a fully open notch). Some specific, potential types of gate failure scenarios are described in further detail below.

Mechanical or Electrical Issues

The gate control system will be designed for methods of contingency operations in the event of a mechanical or electrical malfunction or failure. Manual air bladder valves located in the control building will allow DWR to operate the gate, and an auxiliary power system will allow gate operation (opening or closing) in case of a power failure. A failure of the air bladder would be highly unlikely but would result in the gate being in the down position, continuing to provide the intended fish passage objective to reduce stranding.

Debris or Other Obstructions

Most river debris that becomes lodged on or near the weir settles along the southern half of the weir, although debris could still end up lodged on the weir's northern end. Large debris (or other obstructions, such as sediment) lodged within the notch could prevent the opening or closing of the gate and could alter hydraulics through the notch. In such cases, the debris would be removed when conditions allow.

Additional/Emergency Gate Closure

Beyond normal operations and the other contingencies described above, certain emergency, maintenance, and/or fish rescue scenarios may require DWR to close the gate prematurely partially or fully:

- A structural issue could arise (*e.g.*, erosion or undermining that may lead to structural failure). In this case, the gate may need to be closed immediately to prevent further flow through the notch.

- If a maintenance action or fish rescue were to be initiated when the river is still flowing into the bypass through the notch, the gate may need to be partially or fully closed (*i.e.*, before full drainage of the basin). Such a maintenance action may involve removing sediment or debris from the basin that is obstructing the pathway for fish movement.

- Unforeseen emergency situations may require a partial or full closure of the gate to stop or restrict water level drawdown within the basin, or to further control or alter flow to the bypass.

Maintenance

Tisdale Weir is an existing SRFCP facility operated by DWR. The existing maintenance objectives for this facility aim to maintain flow design capacity, proper functioning of the structure, the facility's visibility and accessibility, and consistency with Federal and State requirements, plans, and policies.

As part of the proposed action facilities and operations are being designed and operated to the extent feasible to maximize the frequency and duration of passable events for fish at Tisdale Weir. In an effort to maximize passage and reduce stranding the location, timing, and/or frequency of some existing maintenance activities may change, but the nature of the activities themselves would not differ substantially from existing practices.

New Maintenance

New project facilities that will require maintenance, as needed, include the proposed weir notch; the operable gate; the baffle fishway elements; electrical, mechanical, and communication controls and housing; the air distribution system (for the gate bladder); the connection channel and basin; and the closed-circuit security cameras and other monitoring equipment. Maintenance actions for the project facilities will be mostly of the same scope and nature as those currently implemented at other DWR facilities. Maintenance in the action area will occur during the dry season, generally starting on or about April 30 and completed by October 31.

Based on historical observations, sediment and debris (*e.g.*, large wood) will likely accumulate on portions of Tisdale Weir and in the basin. Sediment and scour are surveyed at a minimum on an annual basis during the summer maintenance period. Any excessive scour will be repaired during the course of regular summer maintenance when water is not present.

Typically, DWR's maintenance staff adheres to operational guidelines dictated by USACE and documents the maintenance and operations undertaken. Typical new maintenance activities may include the following:

- Remove or level sediment deposits, debris, and undesirable vegetation along the weir, in the basin, along the baffle fishway elements, or within the connection channel and notch/gate.

- Remove obstructions/debris from within the weir or basin access points (*e.g.*, basin access ramp).

- Repair erosion around the structures that could be caused by a change or an increase in flow velocity or direction.

- Repair any damage to the operable gate, and repair and replace operation gauges, sensors, and air distribution piping. Replacement of entire air bladder is expected to be required within 15–30 years.

- Repair the weir or connection channel structures. This work could include removing and replacing broken, heaving, or deteriorated concrete; inspecting the concrete superstructure; replacing attached baffle fishway elements and patching any cracks and spalls. Concrete will be removed using a jackhammer and/or backhoe. Light grading and form work may also be required to replace the concrete. This work is expected to occur in the dry in most years, but in higher water years may require a temporary cofferdam and dewatering to do concrete repairs on the Sacramento River side of the weir. Weir inspection and repair activities are described further and addressed in the USACE Tisdale Weir and Bypass Supplement to Standard Operation and Maintenance Manual (USACE 1955).

- Repair and maintain the mechanical, electrical, and air distribution systems. Staging, materials stockpiling, and equipment access for these activities will be carried out in developed or disturbed areas of the project site, including roads and level areas that are used regularly for facility maintenance.

Maintenance of the Weir Notch, Operable Gate, Baffles, and Connection Channel

The weir notch, gate, baffle fishway elements, and connection channel will be maintained both as needed and at more regular intervals. The fish passage facilities will be monitored regularly during operation for at least 5 years (see Fish Monitoring Plan). Routine monitoring will consist of visual inspection for debris, flow, presence of fish, and sediment accumulation to ensure proper facility functionality.

During periods of safe access to the fish passage facilities, presumably when Tisdale Weir is not overtopping, any debris lodged in the notch, gate, and/or baffles will be cleared. A crane or excavator will likely be needed for large debris. In addition, as conditions permit, after each gate operating cycle, when the river stage has receded below the connection channel invert, the gate will be inspected and cleared of any debris that appears likely to impair gate operations (see Fish Monitoring Plan). The proposed equipment pad will facilitate access to the notch and part of the connection channel (*e.g.*, the pad would allow an excavator or crane to access the notch in case of emergency or imminent damage from large debris).

"EL" baffles along the connection channel will be designed to "break-away" in the event of unforeseen debris impingement or other high velocity conditions as to not damage the structure.

<u>*Annual/Routine Maintenance*</u>

Outside of the flood season, routine maintenance will be performed at the fish passage facilities. Gate maintenance will include washing the steel components to reduce corrosion; applying corrosion protection coating; inspecting the air bladder and repairing leaks or tears; inspecting air compressor components; and torqueing main anchor bolts once in the spring and once in the fall, or as needed. Gate maintenance may also include straightening or welding damaged portions, as well as inspecting, testing, and repairing electrical or hydraulic systems. Maintenance of the equipment atop the equipment pad area will include cleaning exterior and interior equipment and cabinets of dust and debris; checking the tightness of screws and bolts and tightening as needed; and inspecting parts of the generator, batteries, and/or monitoring and data collection instrumentation and replacing them as needed. The concrete at the fish passage facilities will be cleared of debris and sediment and inspected and repaired for cracking, scaling, or spalling.

Sediment and debris may accumulate in the connection channel, particularly along the baffles. However, such accumulation is expected to be comparatively limited, as the connection channel and notch will generally be subjected to relatively high scouring velocities, particularly on the receding limb of the flood hydrograph. Thus, the connection channel is expected to be self-maintaining to a large degree. However, periodic removal of sediment and debris from the connection channel, baffles, and notch may be required. This work will involve removing accumulated sediment, debris, and/or vegetation from within the connection channel, gate, and/or notch to maintain the fish passage function and prevent structural damage. The connection channel will also be inspected each year for areas of potential scour, and additional engineered streambed material and/or riprap would be placed as needed.

Frequency and Timing

Sediment and debris removal activities will generally be conducted annually, between April and November. However, the frequency may vary based on the type of water year (*e.g.*, very dry or very wet); the rate at which sediment and debris accumulate; and the potential need for emergency maintenance to allow fish passage and/or prevent damage to the gate or connection channel. DWR Maintenance Yard personnel would endeavor to conduct this work when the connection channel is dry or when water levels are at their lowest outside the flood season for regulated streams.

Equipment

It is anticipated that maintenance will require the use of one or more light-duty trucks, cranes, excavators, loaders, dump trucks, graders, bulldozers, and/or chain saws for removal of sediment and large wood debris.

Emergency Maintenance Actions

In some instances, wood debris, sediment, or other obstructions may need to be immediately assessed and/or removed from the notch, operable gate, baffles, or connection channel during flood season. For example, debris that has accumulated in the connection channel during high flows may cause hydraulic conditions that present an immediate risk to structural integrity and/or preclude fish passage.

The first step in such cases would be to assess the risk or condition and initiate a maintenance action if life safety or structural damage is imminent and/or fish passage is precluded. However, a maintenance action would subsequently be initiated only if deemed safe for staff and the needed equipment. Access would be provided via the adjacent equipment pad or the access road along the connection channel, and a crane or excavator would likely be used to remove the material.

Energy Dissipation and Fish Collection Basin

Annual/Routine Maintenance

Sediment and debris removal will involve removing or displacing accumulated sediment, debris, and other live or dead vegetation from within the basin to maintain the energy dissipation and fish passage functions of the weir and basin. After the removal of the sediment and debris, the basin's elevations and volume would generally be within the specified range defined by the proposed design.

Sediment and debris removal activities will generally require accessing the basin via the proposed basin access ramp. Depending on the amount of sediment remaining after on-site balancing into scour areas, the sediment may be hauled in trucks to the spoils site; placed on access roads, toe roads, private property, or agricultural lands with appropriate approvals; or disked into the ground or road surface, once dry. A water truck may be used to minimize dust during sediment removal and grading or disking, if needed. Scrapers, bulldozers, backhoes, loaders, graders, long-armed excavators, bobcats, pickup trucks, hand tools, or other appropriate equipment will be used to remove sediment.

Sediment deposition is anticipated to occur after overtopping events and when the Sacramento River is connected to and flowing into the basin and Tisdale Bypass. Sediment removal activities will occur when little to no water is present in the basin to avoid impacts to fish.

Frequency and Timing

Sediment and debris removal activities will generally be conducted annually between April 30th and October 31st. However, the frequency may vary based on the type of water year (*e.g.*, very dry or very wet); the rate at which sediment and debris accumulate; and the effects of the magnitude of accumulated sediment and debris on conveyance capacity, energy dissipation, and fish passage. Maintenance yard personnel will endeavor to conduct this work when channels are dry or when water levels are at their lowest outside the flood season.

Work Area

The annual area of work for sediment and debris removal activities for the project will be, at most, equivalent to the project footprint. The work area for maintenance activities could extend into the areas highlighted in Figure 2 below, approximately 7.2 acres of area within the Tisdale Bypass (Wong 2023). Those areas may experience temporary impacts such as soil disturbance, vegetation mowing, or debris burning associated with maintaining the weir and fish passage facility.

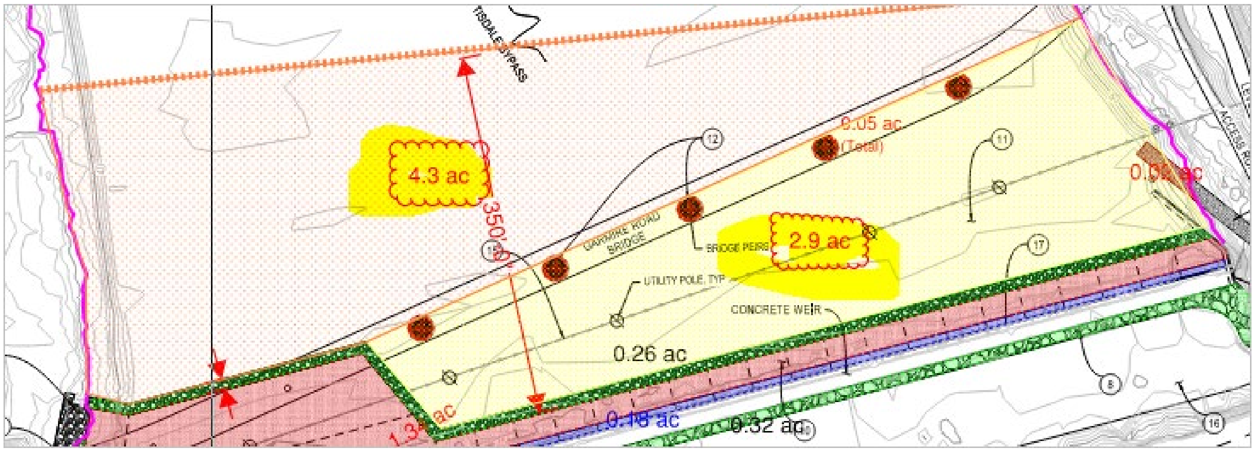

Figure 3. Extent of potential annual maintenance activities.

Equipment

It is anticipated that maintenance will require the use of one or more light-duty trucks, excavators, loaders, dump trucks, graders, bulldozers, and/or chain saws for removal of sediment and large wood debris.

Maintenance Actions

Accumulation of wood debris, sediment, or other obstructions in the basin may block or otherwise prevent passage out to the river. For example, when little or no water is flowing into the basin (*e.g.*, late on the receding limb of an overtopping event, when the river stage is well below the weir crest), a large deposit of sediment could result in inadequate flow depths and prevent passage to the river.

In such an event, and if conditions and resources permit, DWR will initiate a maintenance action to alleviate or remove the obstruction and restore passable conditions. DWR will gain access to the notch via the adjacent equipment pad. If DWR could address the problem using the appropriate equipment (*e.g.*, a crane or long-arm excavator), DWR would attempt to remove the debris/obstruction when safe and make necessary repairs or replacements before resuming normal gate operations. Personnel would access the basin via the proposed basin access ramp.

However, conditions in the basin could change quickly, which would be taken into consideration when assessing the need for or the feasibility of a maintenance action. For example, if another weir overtopping event is imminent and would likely force sediment or debris to move, thus altering basin conditions, it would be more prudent to postpone any actions until after another overtopping event.

Hinge Point Considerations

Large-scale removal of sediment from the entire Tisdale Bypass is carried out periodically, approximately once every decade, to maintain hydraulic capacity. The project's performance objectives will be considered and, as appropriate, integrated into this maintenance completed in downstream areas of the bypass. Should it be determined in the future that sediment removal from the bypass is needed, the project will consider at that time whether sediment removal may affect the hinge point elevation. No sediment removal has occurred in this area during previous removal efforts.

Historically, a sill elevation, or "hinge point," has built up and persisted in the Tisdale Bypass, likely because of both natural sediment deposition in the bypass and the influence of the Sutter Bypass backwater from downstream. This hinge point resides approximately 1,000–1,500 feet downstream of Tisdale Weir. It generally controls when flow down the Tisdale Bypass ceases, and thus controls water elevations on the downstream side of the weir and within the footprint of the basin.

The hinge point is currently at an elevation of approximately 37 feet and is anticipated to remain at a similar elevation. The persistence of this controlling feature would be important to the function of the proposed basin during lower flow conditions, when the river would be connected to the basin, yet the weir would not be overtopping. Based on a topographic differencing analysis, little change to the elevation of this feature occurred between 2007 and 2017 (less than 1 foot of aggradation).

1.3.5. Conservation Measures

To avoid and minimize effects of the proposed action, a number of avoidance and minimization measures are included within the description of the proposed action. All the conservation measures are incorporated by DWR as part of the description of the proposed action, meaning they are proposed as elements of the proposed action and are to be considered in conducting the environmental analysis and determining effects and findings. The proposed action will incorporate the conservation measures listed below.

General Environmental and Water Quality Measures

DWR will minimize fish habitat disturbance if avoidance is not feasible by implementing the following measures:

GM - 1. Before any work occurs within the project site, including equipment staging and vegetation removal, a qualified biologist (familiar with the resources in the area) will conduct a mandatory environmental awareness training. The training will be provided to all construction personnel (contractors and subcontractors), briefing them on the need to avoid and minimize effects on sensitive biological resources within the project site and the penalties for not complying with applicable Federal and State laws and permit requirements. The biologist will inform all construction and maintenance personnel about the life history and habitat requirements of special-status species with potential for occurrence on-site, and the terms and conditions of the biological opinion or other authorizing document (*e.g.*, letter of concurrence).

GM – 2. DWR and the construction contractor will prepare and implement a site-specific storm water pollution prevention plan (SWPPP), consistent with State Water Resources Control Board and Regional Water Quality Control Board (Regional Water Board) requirements for a General Permit for Storm Water Discharges Associated with Construction Activity.

GM – 3. DWR will ensure that any hazardous materials are stored at the staging areas and with an impermeable membrane between the ground and hazardous materials, and that such materials are contained to prevent the discharge of pollutants to groundwater and runoff water.

GM – 4. DWR will arrange for cleanup by qualified individuals of any fuel or hazardous waste leaks or spills at the time of occurrence in a safe manner.

GM – 5. DWR will notify the Regional Water Quality Control Board, NMFS, and CDFW of any leaks or spills within 24 hours. DWR will contain hazardous products properly and dispose of any unused or leftover hazardous products off-site. DWR will use and store hazardous materials, such as vehicle fuels and lubricants, in designated staging areas away from stream channels and wetlands, as applicable.

GM – 6. Construction vehicles and equipment will be checked daily for leaks and will be maintained properly to prevent contamination of soil or water from external grease and oil or from leaking hydraulic fluid, fuel, oil, and grease.

GM – 7. Erosion control devices used at the project site will be free of monofilament plastic netting or tightly woven jute netting that could trap wildlife. Erosion control materials may include burlap-wrapped fiber rolls, coconut coir matting, sediment fencing, and tackified hydroseeding compounds.

Measures for Listed Fish Species

The following measures will be implemented to reduce impacts to listed fish species:

FM – 1. In-water construction activities, including cofferdam construction (sheet pile installation) and dewatering, will be restricted to July 1 to September 30 when listed fish species are less likely to occur within or near the project site. If in-water work can be avoided during cofferdam installation because the river is low enough that the cofferdam installation occurs on dry land, outside of the water, then cofferdam construction may start as early as April 30. Work will be suspended if Tisdale Weir is forecast to overtop during the construction window.

FM – 2. If project activities must occur during non-daylight hours, a designated biologist will establish monitoring measures, including frequency and duration, based on fish species, individual behavior, and type of construction activities. When nighttime work cannot be avoided, nighttime lighting will be used only in the portion of the project area actively being worked on (limited to a minimum distance of 200 feet from habitat for listed fish species) and will be focused directly on the work area. Lights on work areas will be shielded and focused to minimize lighting of listed fish species habitat. If the work area is located near surface waters, the lighting will be shielded to avoid shining directly into the water.

FM – 3. To avoid or minimize the potential for injury or mortality of listed fish species from pile driving noise, all pile driving for the cofferdam will be restricted to the in-water work period (July 1 to September 30) with exception that the cofferdam may be installed earlier, starting April 30, if water levels within the river are low enough such that the cofferdam installation occurs on dry land, outside of the water. Non-impact pile driving methods (*e.g.*, vibratory) are planned. Although pile driving using an impact hammer is not planned, based on the noise attenuation calculations spreadsheet, the impact hammering avoids sound levels that exceed thresholds that would cause onset of physical injury to fish. Therefore, while not likely, impact pile driving may be used under certain circumstances.

a) Peak sound pressure level = 206 decibels (dB) (re: 1 micropascal [µPa])

b) Accumulated sound exposure level = 183 dB (re: 1µPa2 s) for fish greater than 2 grams

c) Soft Start Pile Driving. In-water pile driving and pile driving within 100 linear feet of the water's edge will not commence until warning noises and vibrations are provided in an escalating series to reach the maximum sound levels as described in FM 3a, which provides aquatic species a warning to evacuate the area.

FM – 4. A designated biologist will be onsite when work is planned to occur in water or near the water's edge or any time where disturbance of Endangered Species Act (ESA) listed fish species may be possible. The designated biologist will be present during cofferdam installation and removal to monitor construction activities and compliance with the terms and conditions of permits. For pile driving occurring in the water using an impact hammer, hydroacoustic monitoring of underwater sound levels will be performed to ensure compliance with established thresholds. If any salmonids or sturgeon are found dead or injured during pile driving activities, NMFS and CDFW will be notified immediately, and in-water pile driving will cease.

DWR will submit in writing to NMFS and CDFW the name, qualifications, business address, and contact information of a biologist(s) (designated biologist) at least 30 days before starting cofferdam activities that occur in the water. DWR will ensure that the designated biologist is knowledgeable and experienced in the biology and natural history of the listed species. The designated biologist will be responsible for monitoring in-water cofferdam activities to help minimize and avoid incidental take of listed species and to minimize disturbance of covered species' habitat.

DWR will obtain NMFS, USFWS, and CDFW approval of the designated biologist in writing prior to starting in-water cofferdam activities and will also obtain approval in advance in writing if the designated biologist must be changed.

Biological Monitors- The designated biologist may authorize biological monitors to assist in ESA compliance efforts, under the direct supervision of the designated biologist. The designated biologist is responsible for assuring that any biological monitors working under his or her direct supervision is knowledgeable and experienced in the biology and natural history of the listed species, the terms and conditions of the biological opinion, the ESA definition of "take", and in implementation of standard avoidance and minimization measures used on construction projects.

FM – 5. If noise thresholds are not met using the above measures, DWR will consult with the NMFS and CDFW on the application of other mitigation methods, as feasible (*e.g.*, using bubble curtains and/or reducing the daily duration of pile driving activities).

FM – 6. DWR will conduct turbidity monitoring during all in-water work that occurs in the Sacramento River. The Basin Plan for the Sacramento River and San Joaquin River Basins (Fifth Edition) (Basin Plan) (Central Valley Regional Water Board 2018) contains turbidity objectives. The plan should align with the Clean Water Act Section 401 permit requirements Specifically, the plan states :

d) Where natural turbidity is between 5 and 50 nephelometric turbidity units (NTU), turbidity levels may not be elevated by 20 percent above ambient conditions.

e) Where ambient conditions are between 50 and 100 NTU, conditions may not be increased by more than 10 NTU.

f) Where natural turbidity is greater than 100 NTU, increases will not exceed 10 percent.

FM – 7. A sampling methodology for turbidity monitoring will be developed and implemented based on specific site conditions, project activities, and in consultation with the Regional Water Board. If turbidity limits exceed Basin Plan standards, construction related earth-disturbing activities will slow to a point that will alleviate the problem.

Fish Rescue During Construction-Related Dewatering

FR – 1. DWR will submit a dewatering and fish rescue plan to NMFS and CDFW before construction. NMFS- and CDFW-approved fish biologists will conduct fish rescues, as needed, in the cofferdam area before dewatering. Fish rescue will also occur in the unlikely event that Sacramento River flows overtop the cofferdam. Methods used for capturing fish may include seining and dip netting. Initial turbid water would be pumped into the Tisdale Bypass. Pump intakes will be fitted with appropriately sized, NMFS- and/or CDFW-approved fish screens to prevent fish from becoming entrained.

<u>Fish Rescue and Relocation Plan</u>

DWR will prepare and implement a fish rescue and relocation plan (FRRP) to minimize fish entrainment and/or stranded during construction, maintenance, and operations. The plan will include, at minimum: 1) a list of fish species that may be encountered, 2) descriptions of the proposed methods and equipment to be used to prevent fish stranding, 3) the proposed timing of fish relocation activities, 4) the proposed location where captured fish will be released, and 5) the qualifications of the approved fish biologist implementing the plan. DWR will submit the FRRP to CDFW and NMFS no less than ten (10) business days prior to planned dewatering for construction and maintenance activities. During project operations, DWR will confirm the application of the FRRP and include it (and any updates) as an appendix to the annual technical memorandum. DWR can confirm by email the intent to use the same FRRP or provide any update to the FRRP as needed. The FRRP will be provided prior to an overtopping event, which is likely around the month of October or November. The requirements described below apply only to the rescue and relocation of fish species covered in the 2023 DWR BA, and not to other species of fish.

DWR will incorporate the following requirements into the FRRP:

a) DWR will conduct fish rescue and relocation efforts in accordance with project permits.

b) Fish rescue and relocation operations will occur at all in-water construction or in-water maintenance sites where dewatering and resulting isolation of fish may occur, with the exception that debris removal from a location such as the fish channel can occur to release the water and fish to allow them to maneuver/swim through the channel and out to the Sacramento River.

c) The approved fish biologist(s) will, in consultation with CDFW and NMFS, determine appropriate site-specific procedures for excluding fish from construction/maintenance areas, removing fish from construction/maintenance areas should they become trapped, and preventing fish from reentering construction/maintenance areas prior to dewatering based on site-specific conditions and construction/maintenance activities.

d) Each team conducting fish rescue and relocation efforts will include at least one approved fish biologist.

e) To avoid and minimize the risk of injury to fish and where it can be safely done, attempts to seine and/or net fish will always precede the use of electrofishing equipment. Electrofishing will be conducted in accordance with NMFS and other appropriate fish and wildlife agency guidelines.

f) DWR will include the results of all fish capture and relocation efforts in the annual technical memorandum, including, but not limited to, date, time, location, comments, method of capture, fish species, number of fish, life stage, condition, release location, and release time.

g) The approved fish biologist will place dead fish (species list described in this BA) in sealed plastic bags with labels indicating species, location, date, and time of collection, store them on ice then freeze as soon as possible. DWR will notify both NMFS and CDFW to determine which agency will receive the frozen specimens. Transference of dead fish species will be coordinated with NMFS or CDFW Region 2 District Fisheries Biologist for Sutter County. DWR will notify CDFW and NMFS of any lethal take that occurs within 24 hours. Dead fish observed within the project area that were obviously handled by other survey methods, such as carcass surveys upstream, will not be collected by DWR.

FR – 2. DWR will monitor the project for a minimum of 5 years that water overtops the Tisdale Weir and flows from Sacramento River to the Tisdale Bypass to evaluate the project success (reduction in fish stranding) and determine any fish rescue needs. The number of years can be increased if the TWG recommends more information is needed to determine the success of the project. The TWG team will consist of representatives from DWR, NMFS, and CDFW. At this meeting, participants will determine the appropriate timing for future meetings including how often and when to start the meetings. Language may also include a determination as to when a meeting is not warranted such as no significant spill events occurred. The TWG participants will work toward defining existing uncertainties about the facility's performance or fish passage based on information gathered during monitoring. The TWG will also develop triggers for fish rescue events during project operation, estimate net improvements to passage and stranding and discuss adaptive measures regarding operational advice that could be employed if objectives are not being met. The guidelines for the TWG will be described in the adaptive management plan, otherwise called the long-term management plan (LTMP) (see details in the adaptive management measure below). A fish rescue could be needed due to physical obstruction, mechanical failures within the fish passage facilities, observations that fish in the basin are in poor health, or other unforeseen reasons deemed necessary to conduct a fish rescue.

Adaptive Management

AM – 1. After construction is completed, operation of the fish passage facilities and reductions in fish passage stranding will be monitored and evaluated to provide feedback on project operations (Fish Rescue and Relocation Plan; FRRP). Project operational changes may be necessary to meet the objective of reducing fish stranding. Adaptive management will be an annual (depending on overtopping events), iterative process based on a review of executed operations and any monitoring data collected.

The TWG is anticipated to have qualified technical experts from DWR, NMFS, and CDFW. After 5 years, the need to continue convening the TWG will be evaluated. Adaptive management will include the following components as administered by the TWG:

a) Adaptive Management Plan: An adaptive management plan or LTMP will be developed. This plan will guide discussion into any recommendations for future operational changes that may need to be considered, as is appropriate. For any operational changes, DWR will have to consider many factors beyond fish passage needs such as employee safety, river flows and splits, hydrology, feasibility, etc. The plan will also provide the contents for organizing discussion around annual reporting expectations, defining existing uncertainties about facility performance or fish passage that can be evaluated during monitoring, developing potential triggers for fish rescue events during project operation, estimating net improvement to passage and stranding, and discussing adaptive measures that could be employed if objectives are not being met.

b) Annual Process (annual technical memorandum): Monitoring will be based on overtopping events. No later than on August 31 of each year, DWR will submit an annual technical memorandum to the TWG members covering the previous overtopping season. DWR may submit a written request for a variance within which to submit the annual technical memorandum for unforeseen circumstances. The annual technical memorandum will (1) synthesize operations and study results from any biological and physical monitoring and rescues conducted after overtopping events; (2) include an analysis of the take of species during the covered season; and (3) include a review of the operations and lessons learned from the covered season.

c) Monitoring: To monitor and evaluate the performance of the notch/gate/channel structure, biological and physical data will be collected. The monitoring plan will follow the FRRP (below) for the project.

    i. Biological Monitoring – Observe/document fish activities including stranding and determine if fish are present in inundated areas.

    ii. Physical Monitoring – Monitoring will include measurements of depth, temperature, and dissolved oxygen as well as monitoring of debris buildup in the fish collection basin when feasible and conditions are safe.

iii. ARIS Camera – An ARIS camera will be installed, and data collected by DWR for 5 years when the weir is overtopped and flows more than 4 hours. DWR can add years of data collection if after 5 years the TWG believes more information needs to be gathered to help assess the success of the project. The timeframe of the extended data collection will be determined by the TWG. Data will be collected during the higher velocities through the notch. This data will help determine if sturgeon are passing through the weir.

1.3.6. Fish Rescue and Relocation Plan (FRRP)

Monitoring for fish stranding (as safety allows):

Closed Gate (<4 hours overtopping) --- (5 flood-event years)

After an overtopping event recedes and when river forecasts do not indicate additional overtopping within the next 5 days*:

- Environmental Scientist (ES) staff will observe/document fish activities including stranding by visual observation.
- DWR staff may also use security cameras that can be trained on the dissipation basin/fish channel to observe fish activities.
- If ES determines fish are present or if flood debris impedes full observation of the inundated area, an evaluation will be made on how to remove obstruction to allow safe access into the basin.
- If fish are observed, ES staff will collect water temperature, depth, and dissolved oxygen (DO) readings.

Open Gate (>4 hours overtopping) --- (5 flood-event years):

After water recedes below the weir, but while water remains in the alcove (river stage 33 through 37), during late season gate closures, and when water recedes to stage 33 or below (the alcove has drained):

- ES staff will drive to the site to observe/document fish activities including stranding by visual observation.
- DWR staff may also use security cameras that are trained on the dissipation basin/fish channel to observe fish activities.
- Electronic readings are collected for the following: water temperature, elevation, and DO.
- When water drains from the alcove, ES staff will observe/document accumulated sediment and vegetation; areas of scour, pools, or ponding; or other debris and determine if fish are stranded as a result. If ES determines fish are present or if collected flood debris impedes full observation of the inundated area, an evaluation will be made on how

to remove obstruction to allow safe access into basin.

Fish Rescue

DWR will conduct fish rescues and consult with CDFW and NMFS as appropriate for fish species covered under this BA. For any fish handling needs under this BA, DWR will utilize a CDFW- and NMFS-approved fish biologist. DWR will support this individual in the effort to conduct fish rescues as described in the FRRP. This effort will likely be similar in structure to the California Interagency Anadromous Fish Rescue agreement.

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 several 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.

2.2. 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 critical habitat throughout the designated area, evaluates the conservation value of the various watersheds and coastal and marine environments that make up the designated area, and discusses the function of the PBFs that are essential for the conservation of the species. See Table 2 for species and Table 3 for critical habitat information.

Table 2. Description of species, current ESA listing classification and summary of species status.

Species and Recovery Plans	**Listing Classification and Federal Register Notice**	**Status Summary**
Sacramento River winter-run Chinook salmon Evolutionarily Significant Unit Final Recovery Plan for the ESUs of SR Winter-Run Chinook Salmon and Central Valley Spring-Run Chinook Salmon and the Distinct Population Segment of California Central Valley Steelhead (CV salmonid recovery plan, NMFS 2014)	Endangered, 70 FR 37160; June 28, 2005	According to the previous NMFS species status review (NMFS 2016c), the status of the SR winter-run Chinook salmon ESU, the extinction risk has increased from moderate risk to high risk of extinction since the 2007 and 2010 assessments. Based on the Lindley et al. (2007) criteria, the population is at high extinction risk in 2019. High extinction risk for the population was triggered by the hatchery influence criterion, with a mean of 66 percent hatchery origin spawners from 2016 through 2018. Several listing factors have contributed to the recent decline, including drought, poor ocean conditions, and hatchery influence. Thus, large-scale fish passage and habitat restoration actions are necessary for improving the SR winter-run Chinook salmon ESU viability. The overall status of the SR winter-run Chinook salmon ESU likely has declined since the 2015 viability assessment (Williams et al. 2016) due to the recent increase in hatchery influence. Viability information since the 2015 viability assessment (SWFSC 2022) has been incorporated into the analysis of this consultation and will be reflected in the updated status review in 2023.
Central Valley spring-run Chinook salmon ESU CV salmonid recovery plan (NMFS 2014)	Threatened, 70 FR 37160; June 28, 2005	According to the NMFS previous species status review (NMFS 2016b), the status of the CV spring-run Chinook salmon ESU, until 2015, had improved since the 2010, 5-year species status review. The improved status is due to extensive restoration, and increases in spatial structure with historically extirpated populations (Battle and Clear Creeks) trending in the positive direction. Recent declines of many of the dependent populations, high pre-spawn and egg mortality during the 2012 to 2016 drought, uncertain juvenile survival during the drought are likely increasing the ESU's extinction risk (Williams et al. 2016). Monitoring data showed sharp declines in adult returns from 2014 through 2020 (CDFW 2022). Viability information since the 2015 viability assessment (SWFSC 2022) has been incorporated into the analysis of this consultation and will be reflected in an updated status review in 2023.
California Central Valley steelhead Distinct Population Segment	Threatened, 71 FR 834; January 5, 2006	According to the NMFS previous species status review (NMFS 2016a), the status of CCV steelhead appears to have remained unchanged since the 2011 status review that concluded that the DPS was likely to become endangered within the foreseeable

CV salmonid recovery plan (NMFS 2014)		future throughout all or a significant portion of its range. Most natural-origin CCV populations are very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to natural-origin fish. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead. While updated data on steelhead in the American River is mostly based on hatchery returns, natural spawning populations within the Sacramento tributaries have fluctuated, but showed a steady decline in the past 10 years (Scriven et al. 2018). Viability information since the 2015 viability assessment (Williams et al. 2016) has been incorporated into the analysis of this consultation (SWFSC 2022) and will be reflected in an updated status review in 2023.
Southern Distinct Population Segment of North American Green Sturgeon Recovery Plan for the Southern DPS of North American Green Sturgeon (NMFS 2018)	Threatened, 71 FR 17757; April 7, 2006	According to the NMFS recent species status review (NMFS 2021) and the 2018 final recovery plan (NMFS 2018), some threats to the species have recently been eliminated, such as take from commercial fisheries and removal of some passage barriers. Also, several habitat restoration actions have occurred in the Sacramento River Basin, and spawning was documented on the Feather and Yuba rivers. However, the species viability continues to face a moderate risk of extinction because many threats have not been addressed, and the only spawning location that is known to support the sDPS occurs in a single reach of the main stem Sacramento River. Current threats include poaching and habitat degradation. A recent method has been developed to estimate the annual spawning run and population size in the upper Sacramento River so species can be evaluated relative to recovery criteria (Mora et al. 2018). Although passage improvements have occurred at Fremont Weir and spawning events have been documented in the Feather and Yuba rivers, no changes to the species status or threats are evident since the last review (NMFS 2021).

Table 3. Description of critical habitat, designation details, and status summary.

Critical Habitat	**Designation Date and Federal Register Notice**	**Description**
Sacramento River winter-run Chinook salmon ESU	June 16, 1993; 58 FR 33212	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. PBFs considered essential to the conservation of the species include: Access from the Pacific Ocean to spawning areas; availability of clean gravel for spawning substrate; adequate river flows for successful spawning, Incubation of eggs, fry development and emergence, and downstream transport of juveniles; 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; and access to downstream areas so that juveniles can migrate from spawning grounds to the San Francisco Bay and the Pacific Ocean. Although the current conditions of PBFs for SR winter-run Chinook salmon critical habitat in the Sacramento River are significantly limited and degraded, the habitat remaining is considered highly valuable.
Central Valley spring-run Chinook salmon ESU	September 2, 2005; 70 FR 52488	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, the Sacramento River, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water mark. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. PBFs considered essential to the conservation of the species include: Spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas. Although the current conditions of PBFs for CV spring-run Chinook salmon critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.

California Central Valley steelhead DPS	September 2, 2005; 70 FR 52488	Critical habitat for CCV steelhead includes stream reaches of the Feather, Yuba and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, as well as portions of the northern Delta. Critical habitat includes the stream channels in the designated stream reaches and the lateral extent as defined by the ordinary high-water line. In areas where the ordinary high-water line has not been defined, the lateral extent will be defined by the bankfull elevation. PBFs considered essential to the conservation of the species include: Spawning habitat; freshwater rearing habitat; freshwater migration corridors; and estuarine areas. Although the current conditions of PBFs for steelhead critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.
sDPS of North American Green Sturgeon	October 9, 2009, 74 FR 52300	Critical habitat includes the stream channels and waterways in the Delta to the ordinary high-water line. Critical habitat also includes the main stem Sacramento River upstream from the I Street Bridge to Keswick Dam, the Feather River upstream to the fish barrier dam adjacent to the Feather River Fish Hatchery, and the Yuba River upstream to Daguerre Dam. Critical habitat in coastal marine areas include waters out to a depth of 60 fathoms, from Monterey Bay in California, to the Strait of Juan de Fuca in Washington. Coastal estuaries designated as critical habitat include San Francisco Bay, Suisun Bay, San Pablo Bay, and the lower Columbia River estuary. Certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor) are included as critical habitat for sDPS green sturgeon. PBFs considered essential to the conservation of the species for freshwater and estuarine habitats include: food resources, substrate type or size, water flow, water quality, migration corridor; water depth, sediment quality. In addition, PBFs include migratory corridor, water quality, and food resources in nearshore coastal marine areas. Although the current conditions of PBFs for sDPS green sturgeon critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.

2.2.1. Recovery Plans

In July 2014, NMFS released a final recovery plan for SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead (NMFS 2014, Recovery Plan). The Recovery Plan outlines actions to restore habitat and access, and improve water quality and quantity conditions in the Sacramento River to promote the recovery of listed salmonids. Key recovery actions in the Recovery Plan include conducting landscape-scale restoration throughout the Delta, incorporating ecosystem restoration into Central Valley flood control plans that includes breaching and setting back levees, and restoring flows throughout the Sacramento and San Joaquin River basins and the Delta. In August 2018, NMFS released a final recovery plan for the sDPS green sturgeon (NMFS 2018), which focuses on fish screening and passage projects, floodplain and river restoration, and riparian habitat protection in the Sacramento River Basin, the Delta, San Francisco Estuary, and nearshore coastal marine environment as strategies for recovery.

2.2.2. Global Climate Change

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

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

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

For 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, which buffers the effects of warm temperatures in most years. The exception occurs during drought years, which are predicted to occur more often with climate change (Yates *et al.* 2008). Additionally, air temperature appears to be increasing at a greater rate than what was previously analyzed (Lindley 2008, Beechie *et al.* 2012, and Dimacali 2013). These factors will compromise the quantity and/or quality of SR winter-run Chinook salmon habitat available.

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.* 2011). CV spring-run Chinook salmon spawn primarily in the tributaries to the Sacramento River, and those tributaries without cold water refugia, usually provided by springs, will be more susceptible to impacts of climate change. In years of extended drought and warming water temperatures, unsuitable conditions may occur even in tributaries with cool water springs. Additionally, juveniles often rear in the natal stream for one to two summers prior to emigrating and would be susceptible to warming water temperatures. In Butte Creek, fish are limited to low elevation habitat that is currently thermally marginal, as demonstrated by high summer mortality of adults in 2002 and 2003, and will become intolerable within decades if the climate warms as expected.

Although steelhead will experience similar effects of climate change to Chinook salmon, as they are also blocked from the vast majority of their historic spawning and rearing habitat, the effects may be even greater in some cases, as juvenile steelhead need to rear in the stream for one to two summers prior to emigrating as smolts. In the Central Valley, summer and fall temperatures below the dams in many streams already exceed the recommended temperatures for optimal growth of juvenile steelhead, which range from 14°C to 19°C (57°F to 66°F). Several studies have found that steelhead require colder water temperatures for spawning and embryo incubation than salmon (McCullough *et al*. 2001). In fact, McCullough *et al.* (2001) recommended an optimal incubation temperature at or below 11°C to 13°C (52°F to 55°F).

The sDPS green sturgeon spawn primarily in the Sacramento River in the spring and summer. Anderson Cotton Irrigation District (ACID) is considered the upriver extent of green sturgeon passage in the Sacramento River. As water temperatures increase with climate change, temperatures in the upper river in the deeper pools sturgeon tend to spawn in may remain within tolerable levels for the embryonic and larval life stages of green sturgeon, but temperatures at spawning locations lower in the river may be more affected. Successful spawning of green sturgeon in other accessible habitats in the Central Valley (*i.e*., the Feather River) is limited, in part, by late spring and summer water temperatures. Similar to salmonids in the Central Valley, green sturgeon spawning in the major lower river tributaries to the Sacramento River are likely to be further limited if water temperatures increase and suitable spawning habitat remains inaccessible.

In summary, observed and predicted climate change effects are generally detrimental to the species (McClure 2011, Wade et al. 2013), so unless offset by improvements in other factors, the status of the species and critical habitat is likely to decline over time. The climate change projections referenced above cover the time period between the present and approximately 2100. While there is uncertainty associated with projections, which increases over time, the direction of change is relatively 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 is located on the east side of the Sacramento River, approximately 13.5 miles southwest of Yuba City in Sutter County, California. The western boundary of the action area is the Sacramento River immediately west of the existing Tisdale Weir and the parking lot for the County's Tisdale Boat Launch Facility. The eastern boundary of the action area is just east of the Garmire Road Bridge, which traverses the Tisdale Bypass downstream of Tisdale Weir. The action area includes the area of the Sacramento both upstream and downstream up to 1,000 feet away from the extent of the work area where effects of noise, turbidity, or other disturbances are expected to extend. Within the Tisdale Bypass, the area extends east into the bypass to include any areas where sediment disturbance from vehicles or other construction activities may occur during initial construction or long-term maintenance.

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 consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 CFR 402.02).

The proposed action is located at the Tisdale Weir, a flood bypass structure on the east bank of the Sacramento River in California's Central Valley. The Tisdale Weir allows flood flows into the Tisdale Bypass, that directs overflow waters of the Sacramento River into the Sutter Bypass. The project encompasses areas both within the mainstem Sacramento River, and in the Tisdale and Sutter Bypasses.

Sacramento River

The segment of the Sacramento River located within the action area is heavily channelized and leveed and is bordered by agricultural land. The Sacramento River has many water diversions within this region, both screened and unscreened. Agricultural use is generally separated from the river in this area by a levee. Most adjacent land in the region is used for farming, with limited uses for grazing. This section of the river is characterized primarily by slow-water glides and pools, is depositional in nature, and has lower water clarity and habitat diversity relative to the upper portion of the river. Over 30 fish species are known to occur within the Sacramento River. Several of these are anadromous, including both native and non-native species. Anadromous fish species include Chinook salmon (SR winter-run, CV spring-run, fall-run, and late fall-run Chinook salmon), CCV steelhead, sDPS green sturgeon, white sturgeon, Pacific lamprey, river lamprey, American shad, and striped bass. The Sacramento River provides a migration corridor and rearing habitat for salmonids and sturgeon, as well as spawning and rearing habitat for a variety of other native fish species such as Sacramento splittail and Sacramento pikeminnow.

Tisdale and Sutter Bypasses

The Tisdale Bypass is located along the river left bank (east side) of the Sacramento River (river mile 119) about 10 miles southeast of the town of Meridian and 56 miles north of Sacramento, and approximately 13.5 miles southwest of Yuba City in Sutter County, California (DWR 2010). Tisdale Weir is the starting point for the 4-mile-long bypass. Its primary purpose is to release overflow waters of the Sacramento River into the Sutter Bypass via the Tisdale Bypass.

The fixed-crest, reinforced concrete weir is 1,150 feet long. The 4-mile leveed bypass (the Tisdale Bypass) connects the Sacramento River to the Sutter Bypass. The crest elevation is 44.1 feet and the weir is designed to convey 38,000 cfs from the Sacramento River into the Sutter Bypass. Typically, Tisdale Weir is the first of the five weirs in the Sacramento River Flood Control System to overtop and continues to spill for the longest duration. Sutter and Tisdale Bypasses are part of the Sacramento Flood Control Project that was developed in the early 1900s to divert excessive wintertime flood flows from the Sacramento River through a system of weirs and flood relief structures into a series of leveed flood bypasses. The specific purpose of the Sacramento Flood Control Project, is to help reduce the risk of flooding to communities and agricultural lands in the Sacramento Valley and Sacramento-San Joaquin Delta.

The Sutter Bypass flows are heavily utilized for agriculture and waterfowl habitat. The Sutter Bypass has several weirs that are used to increase the water height to flood duck hunting land, agricultural fields, or increase flows for water diversions. Sutter Bypass is the uppermost flood bypass within the Sacramento Flood Control Project. It is 51 km (31.6 miles) long and has a surface area of approximately 15,500 acres. Sutter Bypass conveys flood waters from Butte Basin, the Feather River, and the Sacramento River via the Tisdale Bypass, Colusa Weir, and Moulton Weir, each of which is a concrete structure that passes floodwaters by gravity once the Sacramento River reaches the elevation at which flow overtops the weir. The Moulton and Colusa weirs are overtopped when Sacramento River flows exceed 60,000 and 30,000 cubic feet per second (cfs), respectively (Reclamation 2017). The Tisdale Weir is overtopped when Sacramento River flows exceed 23,000 cfs (Reclamation 2017).

The action area is considered an important rearing and migratory corridor for all anadromous fish species When flows in the Sacramento River are high, water flows over the Tisdale weir and into the Sutter Bypass. Salmonids and sturgeon may enter the Tisdale Bypass if their migration through the Sacramento River coincides with a Tisdale Weir overtopping event. When the weir overtops, fish from the Sacramento River may enter the Tisdale Bypass, and the Sutter Bypass downstream of that. Once fish pass over the fixed crest of the Tisdale Weir, they are generally trapped within the bypass. In rare instances, fish may be able to swim over the weir while it is still overtopping (though high flows and water velocities make this difficult). For fish still behind the Tisdale Weir once flood flows recede, they must either follow waters downstream into the Sutter Bypass which can lead back into the Lower Sacramento River, or they remain trapped behind the Tisdale Weir and must be rescued to return back into the Sacramento River.

Both adult and juvenile fish have the potential to be stranded in the stilling basin of the Tisdale Weir and in nearby scour channels and ponds as floodwaters recede following overtopping events. Fish trapped in the shallow waters of the stilling basin and scour channels are vulnerable to poaching, poor water quality, and falling water levels. The stranding of sturgeon and salmonids behind the Tisdale Weir has been designated as a high priority Recovery Action for CCV steelhead, sDPS green sturgeon, CV spring-run, and SR winter-run (NMFS 2014 and 2018).

2.4.1. Status of the Species in the Action Area

The 2014 NMFS Recovery Plan establishes the criteria for viable salmonid populations within the Central Valley to reach recovery of the species. The recovery plan established the viability of each existing population based on those criteria, which are then re-evaluated every 5 years to determine if the populations viability has changed. Core 1 watersheds are those that possess the ability or potential to support a viable population. Core 2 populations have lower potential to support viable populations, due to lower abundance, or amount and quality of habitat. These populations provide increased life history diversity within the ESU/DPS. Each ESU/DPS is broken down into several diversity groups, which have levels of recovery criteria built within them that also evaluate the viability of a species. The action area is on the mainstem Sacramento River, which is the main migratory corridor for three of the four major diversity groups for salmonids (the Basalt and Porous Lava group, the Northwestern California group, and the Northern Sierra Nevada Group), as well as the whole DPS for green sturgeon.

Sacramento River Winter-run Chinook Salmon

The distribution of SR winter-run Chinook salmon spawning and rearing is currently limited to the upper Sacramento River, approximately 180 river miles upstream of the Tisdale Weir (NMFS 2009). Nearly 300 miles of spawning habitat in the upper Sacramento River above dams is now inaccessible to SR winter-run Chinook salmon (NMFS 2014). Data on the temporal distribution of SR winter-run Chinook salmon upstream migration suggest that in wet years about 50 percent of the run has passed the Red Bluff Diversion Dam (RBDD) structure by March, and in dry years, migration is typically earlier, with about 72 percent of the run having passed the RBDD by March (Poytress *et al.* 2014).

Juvenile winter-run Chinook salmon migrate downstream in the Sacramento River from August through March. When flows reach flood levels, water is diverted via overflows from the Tisdale, Colusa, and Moulton weirs (Reclamation 2018). During these flows, the Tisdale and Sutter

Bypasses can function as a migratory corridor for juvenile winter-run Chinook salmon (Reclamation 2018), though historical CDFW data report they have never been found there in high numbers. When a Tisdale Weir over-topping event coincides with a migration period of either adult or juvenile winter-run, they risk entrainment within the Tisdale Bypass. If flows remain high, juveniles could access the habitat within the Sutter Bypass, and then back into the Sacramento River. If adults are entrained within the bypass, they have little to no opportunity to return back to the Sacramento River, and will likely become stranded behind the weir while trying to continue their upstream migration.

Since 2007, SR winter-run Chinook salmon have declined in abundance with a low of 827 spawning adults in 2011 (NMFS 2016c). As reported in the most recent 5-year status review (NMFS 2016c), the 10-year trend in run size is -0.15 which suggests an annual 15% population decline. Adult SR winter-run Chinook salmon returns in 2016 to 2018 were low, as expected, due to poor in-river conditions for juveniles from brood years 2013-2015 during drought years. The adult SR winter-run Chinook salmon escapement estimates have since increased with the escapement estimates for 2020 at 6,199, 2021 at 9,998, and 2022 at 5,443 adults. With the most recent drought conditions from 2020 through 2022, it is still yet to be determined how the cohorts from those conditions will fair. Due to very high in-river temperatures, poor water quality, and Thiamine deficiency, juvenile recruitment from those years is expected to be very poor. Ocean abundance of salmon in early 2023 led to the closing of the commercial and recreational salmon fishery off the coast of California (PFMF, 2023), followed by an inland salmon fishery closure by the California Department of Fish and Wildlife (CDFW, 2023).

Central Valley Spring-run Chinook Salmon

Adult CV spring-run Chinook salmon may be in the Sacramento River near the Tisdale Weir from February through July (NMFS 2014), many migrating past during their return to natal streams upriver. With the rerouting of Butte Creek, adult spring-run returning to Butte Creek typically enter the East Canal near Verona and travel upstream through the Sutter Bypass, though they can also enter through the Butte Slough Outfall Gates (BSOG), or via the Tisdale Weir if it is overtopping.

Juvenile CV spring-run Chinook salmon near the Tisdale Weir in the Sacramento River occur primarily from November through May, with presence typically peaking during high flows December through March. Juveniles originating within Butte Creek must travel down through the Sutter Bypass or Butte Slough Outfall Gates to get to the Sacramento River. Butte Creek spring-run juveniles migrate downstream primarily from December through February. Life history investigations have shown that many juveniles entering the Sutter Bypass remain there for several weeks. Similarly, as described above for winter-run Chinook, when a Tisdale overtopping event coincides with juvenile or adult migratory periods, fish are at risk for entrainment with the bypass and stranding behind the structure.

California Central Valley steelhead

The mainstem of the Sacramento River serves as a primary migratory corridor for both upstream and downstream migration for all Sacramento River Basin populations of CCV steelhead. Adult and juvenile CCV steelhead can be present in the Sacramento River year-round, although their presence often coincides with high flow events during the late fall through spring. Adult CCV steelhead presence near the Fremont Weir (downstream of the action area) peaks in early October and extends through March (DWR 2017).

Although there are limited observations, Butte Creek origin adult steelhead are thought to ascend through the Sutter Bypass in the late-fall and winter where they proceed to spawn in both the mainstem and tributaries of Butte Creek (Reclamation 2018). Similar to spring-run, the Sutter Bypass is known to be used as rearing habitat by juvenile steelhead as well. Juvenile CCV steelhead passing the action area occur primarily from November through May, typically peaking in February and March (CDFW 2022). Similarly, as described above for other salmonids, when a Tisdale overtopping event coincides with juvenile or adult migratory periods, fish are at risk for entrainment with the bypass and stranding behind the structure.

sDPS Green Sturgeon

In June and July of 2010-2015, Mora et al. (2018) estimated that there were between 1,246 and 2,966 sDPS green sturgeon in the reproductive portion of the population. Approximately 45 percent on average (141 fish), of green sturgeon distribution and abundance in the Sacramento River from 2010 to 2014, were observed above RBDD (Mora). The upper mainstem Sacramento River is the only area where consistent annual spawning by sDPS green sturgeon has been confirmed via the presence of eggs and larvae (Poytress et al. 2015).

Observations of green sturgeon in the Sacramento River have been found as far upstream as near the mouth of Cow Creek (RM 280). Adults migrate upstream typically in winter months (January-March) with spawning mostly concentrated in the mid-April to mid-June time period (Poytress et al. 2011-2012). Post-spawn fish tend to demonstrate two different outmigration patterns. They either hold for several months in the Upper Sacramento River and out-migrate with higher flows in the fall/winter, or they move out of the river quickly after spawning in the late spring/early summer. The post-spawn holding behavior seems to be most commonly observed in the Sacramento River (Heublein et al. 2009, Mora 2016, Miller et al. 2020, Seesholtz 2020). Rotary screw trap monitoring at RBDD has incidentally captured juvenile green sturgeon between May and the end of August. Juvenile green sturgeon are very rarely caught in the RSTs' below RBDD (Tisdale RST and Knights Landing RST), so migration timing below RBDD is mostly unknown. It is expected that adult sturgeon could be present in the Sacramento River near the action area year-round, with juvenile presence likely starting in May/June and continuing through the summer.

Adult and juvenile green sturgeon may enter the Tisdale Bypass over the Tisdale Weir during high flow events. Sturgeon have been documented and rescued from within the Tisdale bypass after high flow events once flows have receded. However, no observations of green sturgeon have been documented within the Sutter Bypass. It can be assumed then that sturgeon either remain within the Tisdale Bypass to become stranded, or they are able to travel downstream with the high flows through the Bypass and back into the Sacramento River. Due to the many weirs and fish ladders present in the Sutter Bypass, adults are unlikely to be able to make it volitionally upstream into the Sutter Bypass from Verona.

2.4.2. Status of Critical Habitat within the Action Area

Designated critical habitat occurs in the action area within the Sacramento River for all four listed species discussed in this opinion. The Tisdale Bypass is also designated critical habitat for green sturgeon, steelhead, and spring-run. The action area contains PBFs that support rearing and migration for Chinook salmon, steelhead, and sturgeon. No spawning habitat occurs in the action area for any of the species discussed in this opinion. The Sacramento River and Tisdale Bypass have high value for the conservation of the species, because they support several life stage functions for each of the four listed species. The area provides much needed juvenile rearing habitat, and functions as both an upstream and downstream migratory corridor. The Bypass reaches include some of the only remaining accessible floodplain habitat, which is important for juvenile life stages. The 2014 NMFS Salmonid Recovery plan recognizes these habitats as essential for the conservation of the species.

The PBFs of critical habitat within the action area essential to the conservation of salmonids include freshwater rearing and freshwater migration corridors. These PBFs include 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 used for freshwater rearing by juveniles, and migration by juveniles and adults. The PBFs of critical habitat within the action area essential to the conservation of sDPS green sturgeon include food resources, substrate type or size, water flow, water quality, migration corridors free of passage impediments, and sediment quality.

Providing passage through the Sutter Bypass is a priority 1 recovery action in NMFS 2014:

- Providing and/or improving fish passage through the Yolo Bypass and Sutter Bypass allowing for improved adult salmonid re-entry into the Sacramento River (long-term)

The 2018 NMFS Green Sturgeon Recovery Plan classifies the passage impediment of Tisdale Weir as a medium level threat to the species, and is identified in recovery action 1d:

- Construction of a structure that will provide volitional passage for upstream migrating adults at Tisdale (and Fremont) Weir

The substantial degradation of critical habitat over time has diminished the function and condition of the freshwater rearing and migration corridor PBFs. Even though the habitat within the action area 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, CCV steelhead, and sDPS green sturgeon.

The magnitude and duration of peak flows during the winter and spring are reduced by water impoundment in upstream reservoirs in the Sacramento River, affecting listed salmonids and sDPS green sturgeon in the action area. Overall, water management now reduces natural variability by creating a highly managed system that is incredibly influenced by water diversions used for agriculture, among other purposes.

Point and nonpoint sources of pollution resulting from agricultural discharge and urban and industrial development occur upstream of, and within, the action area. Environmental stressors as a result of low water quality can lower reproductive success and may account for low productivity rates in fish (Klimley 2002). Organic contaminants from agricultural discharge, 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). Principal 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), as Butte Slough discharges water just north of the Tisdale Bypass, it is safe to assume that the organic contamination from agricultural discharge is also present within the action area. Other impacts to adult migration present in the action area include migration barriers, water conveyance factors, and water quality. The Tisdale Weir has been documented as a substantial migration barrier for many native species within the Central Valley, which is expected to be resolved substantially with the implementation of the proposed action.

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 (see 50 CFR 402.02). 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 402.17). In our analysis, which describes the effects of the proposed action, we considered the factors set forth in 50 CFR 402.17(a) and (b).

2.5.1. Effects to Species

The proposed action includes activities that are likely to adversely affect Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, California Central Valley steelhead, green sturgeon, and their associated critical habitats. The following is an analysis of the effects to the species and their critical habitat that are reasonably certain to occur as a result of the implementation of this project.

Physical Disturbance

Physical disturbance in aquatic habitat will occur during construction as well as ongoing operations and maintenance activities. These disturbances are expected to included activities such as placement of materials (rock, soils, etc.) and debris removal (through mechanical and manual removal methods). These types of activities 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 footprint of the work, 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 and concrete is being placed, and temporarily decreased in areas that will be disturbed during construction, operations, or maintenance activities.

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. The use of a cofferdam for isolating the work area is expected to reduce exposure of fish to active construction activities. During cofferdam installation, 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 due to the disturbance caused by vibrations on land. A low level of injury and death from crushing by construction equipment, cofferdam installation, and maintenance activities such as debris removal is expected to occur, but will be reduced through avoidance and minimization measures.

Due to the long-term operations and maintenance associated with the proposed action, it is expected that a small number of adults and juveniles of each species will be injured or killed as a result of the physical disturbance. Proposed operations and maintenance (O&M) will cause intermittent small-scale physical disturbance over the long-term. While small disturbances from O&M are more commonly expected, some activities, such as mechanical debris removal during fish passage operations, may cause injury or mortality to any adults and juveniles present that are unable to avoid machinery. While mechanical debris removal or other O&M activities within the wetted channel are expected to occur infrequently, it is expected to cause injury or mortality to a small number of fish over the operating life of the structure.

Increased Turbidity and Suspended Sediment

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

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 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). 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.

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.

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. 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 requirement to suspend construction when turbidity exceeds Central Valley Regional Water Quality Control Board (CVRWQCB) standards. 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 due to displacement and lowered visibility caused by the suspended sediment. Proposed operations and maintenance will 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.

Acoustic Impacts

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. Pile driving will occur both within the channel for cofferdam installation, and outside the channel for construction efforts. Large posts will need to be driven to support walls of cofferdams, and as supports for the construction of the fish passage channel.

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. 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).

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). 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). 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 (1996) 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.

The BA proposes to implement protocols consistent with the Interim Criteria for Injury of Fish Exposed to Pile Driving Operations (Popper 2006). This criteria uses a combined interim single strike criterion for pile driving received level exposure; a sound exposure level (SEL) of 187 dB re: 1 µPa2 •sec and a peak sound pressure of 208 dB re: 1 µPa peak 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. While this will be a short-term effect for most fish, small numbers of injury or mortality is expected to occur due to the use of pile driving over five or more construction seasons, and over such a large span of habitat. While pile-driving and general construction noise may cause some localized behavioral disturbances to fish, injury or lethal effects are expected to occur to only a few fish over the course of project implementation.

Proposed O&M 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, and therefore is unlikely to cause injury or death.

Cofferdam Installation and Dewatering

Installation of cofferdams will be necessary during construction as well as during some future O&M activities. Cofferdams will be installed during the proposed work windows when fish will be less prevalent and will only be in place during initial construction or active O&M activities. Cofferdams will remain closed during construction, eliminating the ability for fish to re-enter the area.

Dewatering activities within the cofferdam areas will 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 dewatering pumping activity. Effects related to capture/relocation efforts are described below.

Fish that evade capture and remain in the construction area may be injured or killed from construction activities. This includes injury, desiccation, or death if fish are crushed by personnel or equipment. However, because experienced biologists will be present to ensure proper methods for removing fish from cofferdam areas, most are expected to be removed from the area before construction. While BMPs will reduce effects, injury and mortality of a few fish are still likely due to the large scale of this project over several years of construction.

Stranding, Fish Capture, and Relocation Effects

Fish capture and relocation may need to occur during implementation of the proposed action. Relocation will be needed during activities that require a cofferdam and dewatering, but also may be needed during stranding rescue efforts within the Tisdale Bypass.

For cofferdam installation, fish will be attempted to 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.

The construction of a fish passage facility is expected to significantly reduce the amount of fish stranding that occurs within the Tisdale Bypass, however, some level of stranding is still expected to occur. Stranding is an existing stressor in the Tisdale Bypass. Juveniles seek slower flow habitat as resting stops when the bypass is inundated by higher flows. Adults will seek deeper pools for safety when bypass flows are receding. With normal flow scour, some areas can become isolated pools or even completely dewatered when flood flows reduce, creating opportunity for stranding of both adults and juveniles. CDFW monitoring reports show a range of numbers of different species and runs of anadromous fish observed and rescued in these efforts (CDFW 2011).

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). Juvenile salmonids are particularly susceptible to isolation or stranding during rapid reductions in flow (USFWS 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; Water Forum 2005).

Rescues will be performed by DWR, or other authorized individuals, 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.

Fish relocation activities pose a risk of injury or mortality since any fish relocation or collection gear has some associated risk 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. However, as multiple relocations may need to occur throughout implementation of the proposed action, a small proportion of fish handled are expected to be injured or killed during fish relocation activities.

Chemical Contamination

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 construction of the new fish passage facility. 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. Lime easily dissolves in water and drastically changes the pH of water increasing the alkalinity (pH 11-13), which causes chemical 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. Proposed BMPs regarding safe storage of chemicals, protocols around refueling or working with hazardous materials, and proper monitoring of all work, is expected to minimize risk of exposure. Therefore, water quality degradation from toxic chemicals associated with the project is expected to be improbable, and therefore extremely unlikely to occur.

Fish Passage Facility Operations

Operation of the proposed fish passage structure would provide improved connectivity for listed fish species to enter the Sacramento River from the Tisdale Bypass. As the bypass has had a historic occurrence of stranding both adult and juvenile fish (CDFW 2011), the facility 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 bypass. While the fish passage facility is not likely to completely remedy the existing stranding occurrences along the 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.

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 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. If the blockage is not able to be cleared in a timely manner, it may cause straying, delays in spawning, inability to reach spawning grounds or death. 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 over the life of the project.

The proposed action includes the adaptive management of the facility in order to reduce take and maximize passage. The adaptive management plan will include flexible operations of the facility in coordination with NMFS and CDFW technical staff, is expected to be able to reduce take further, 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 spring-run Chinook salmon, winter-run Chinook salmon, steelhead, and green sturgeon. The general PBFs of critical habitat within the action area are rearing and migratory corridors.

Placement of Riprap and Hardened Surfaces

The continual input of riprap into the Sacramento River will permanently alter critical habitat 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 quantity and quality of freshwater migratory and rearing habitat PBFs for juvenile salmonids and reduce the amount of usable rearing habitat. 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 where submerged riprap is placed.

Within the action area, up to 2 acres of permanent degradation of salmonid and sturgeon critical habitat from riprap placement is expected. The current area around the Tisdale Weir is highly degraded due to the initial construction of the weir. The frequent high flows around the weir and within the bypass do not allow for substantial vegetation growth and overall minimal use of the habitat for rearing. The area is mostly used as a migratory corridor by all listed species. The further degradation of rearing and migratory corridor habitat PBFs in the action area are expected to result in small reductions in growth, reduced survival, and reduced fitness.

Chemical Contamination and Toxic Substance Spills

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 listed 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.

Increased Turbidity and Suspended Sediment

The action area will have temporary increases in turbidity and suspended sediment levels within the project footprint and downstream areas. The resuspension 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 are expected to minimize the extent of adverse effects to critical habitat PBFs to a low level. Proposed O&M 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, it is not expected to cause any long-term impacts to habitat.

Acoustic Impacts from Construction Activities

Impacts to freshwater rearing habitat and migratory corridor PBFs are expected to occur due to construction near the active channel and 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 habitat PBFs to support fish.

Any excessive noise or vibrations may temporarily reduce usage of the habitat within the action area. Suitable habitat within 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 of the proposed action. While small increases in noise may cause some localized behavioral disturbances, they are not expected to cause any effects beyond what is described above.

Beneficial Effects of Improved Fish Passage

Operation of the new fish passage structure will provide improved hydrologic connectivity for ESA-listed fish species migrating between the Sacramento River and the Tisdale Bypass. This enhanced connectivity is expected to considerably improve habitat conditions in the bypass, greatly reduce stranding events below Tisdale Weir, and enhanced connectivity should contribute to increased individual survival as well as likely increasing spawning success for adults migrating through the area. In addition, enhanced hydrologic connectivity between the bypass and the river is anticipated to reduce the necessity and frequency of non-project-related fish rescue efforts below the weir as well as the susceptibility of listed fish to both poaching and predation in the Tisdale Bypass.

After construction in the bypass is complete, the condition and quality of the migratory corridors and rearing habitat PBFs of sDPS green sturgeon, CCV steelhead, and CV spring-run Chinook salmon designated critical habitat is expected to rapidly revert to pre-project conditions, including recolonization of invertebrates and the restoration of functional ecological processes. Furthermore, operation and maintenance of the project-related facilities and structures are expected to improve habitat connectivity and productivity in the bypass. This is anticipated to reduce stranding and allow greater access to the inundated floodplain, thereby conferring long-term benefits to the designated critical habitats for sDPS green sturgeon, CCV steelhead, and CV spring-run Chinook salmon by improving the PBFs of both freshwater rearing sites for juveniles and freshwater migration corridors for all life stages of sDPS green sturgeon, CCV steelhead, and CV spring-run Chinook salmon utilizing both the Tisdale/Sutter Bypass and the Sacramento River.

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 and 402.17(a)]. 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

Water diversions for municipal and industrial use are found near the action area. 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.

Water diversions for irrigated agriculture, municipal and industrial use, and managed wetlands are found along the action area. Depending on the size, location, and season of operation, these unscreened diversions entrain and kill multiple life stages of aquatic species, including juvenile listed anadromous species. For example, as of 1997, 98.5% of the 3,356 diversions included in a CV database were either unscreened or screened insufficiently to prevent fish entrainment (Herren and Kawasaki 2001).

Agricultural practices in the action area may adversely affect riparian and wetland habitats through upland modifications of the watershed that lead to increased siltation or reductions in water flow. Grazing activities from cattle operations can degrade or reduce suitable critical habitat for listed species by increasing erosion and sedimentation, as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which then flow into the receiving waters of the associated watersheds. Stormwater and irrigation discharges related to both agricultural and urban activities contain numerous pesticides and herbicides that may adversely affect listed salmonid and green sturgeon reproductive success and survival rates (Daughton 2002; Dubrovsky et al. 1998).

2.6.2. Increased Urbanization

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 and highways, and public utilities. Some of these actions, particularly those which are situated away from water bodies, will not require Federal permits, and thus will not undergo review through the ESA section 7 consultation process with NMFS.

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

2.6.3. 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 program.

2.6.4. Aquaculture and Fish Hatcheries

More than 32 million fall-run Chinook salmon, 2 million CV spring-run Chinook salmon, 1 million late fall-run Chinook salmon, 0.25 million SR winter-run Chinook salmon, and 2 million steelhead are released annually from six hatcheries producing anadromous salmonids in the Central Valley. All of these facilities are currently operated to mitigate for natural habitats that have already been permanently lost as a result of dam construction. The loss of historical habitat and spawning grounds upstream of dams results in dramatic reductions in natural population abundance, which is mitigated for through the operation of hatcheries. Salmonid hatcheries can, however, have additional negative effects on ESA-listed salmonid populations.

The high level of hatchery production in the Central Valley can result in high harvest-to-escapements ratios for natural stocks. California salmon fishing regulations are set according to the combined abundance of hatchery and natural stocks, which can lead to over-exploitation and reduction in the abundance of wild populations that are indistinguishable and exist in the same system as hatchery populations. Releasing large numbers of hatchery fish can also pose a threat to wild Chinook salmon and steelhead stocks through the spread of disease, genetic impacts, competition for food and other resources, predation of hatchery fish on wild fish, and increased fishing pressure on wild stocks as a result of hatchery production.

Impacts of hatchery fish can occur in both freshwater and the marine ecosystems. Limited marine carrying capacity has implications for naturally produced fish experiencing competition with hatchery production. Increased salmonid abundance in the marine environment may also decrease growth and size at maturity, and reduce fecundity, egg size, age at maturity, and survival (Bigler *et al.* 1996).

2.6.5. Recreational Fishing

While hatchery CCV steelhead and Chinook salmon are targeted, incidental catch of protected species does occur. Since 1998, all hatchery CCV steelhead have been marked with an adipose fin clip, allowing anglers to tell the difference between hatchery and wild CCV steelhead. Current regulations restrict anglers from keeping unmarked CCV steelhead in Central Valley streams.

Current sport fishing regulations do not prevent wild CCV steelhead from being caught and released many times over while on the spawning grounds, where they are more vulnerable to fishing pressure. Recent studies on hooking mortality based on spring-run Chinook salmon have found a 12 percent mortality rate for the Oregon in-river sport fishery (Lindsay *et al.* 2004). Applying a 30 percent contact rate for Central Valley rivers (*i.e.*, the average of estimated Central Valley harvest rates), approximately 3.6 percent of adult steelhead die before spawning from being caught and released in the recreational fishery. Studies have consistently demonstrated that hooking mortality increases with water temperatures. Mortality rates for steelhead may be lower than those for Chinook salmon, due to lower water temperatures.

In addition, survival of CCV steelhead eggs is reduced by anglers walking on redds in spawning areas while targeting hatchery CCV steelhead or salmon. Roberts and White (1992) identified up to 43 percent mortality from a single wading over developing trout eggs, and up to 96 percent mortality from twice daily wading over developing trout eggs. Salmon and trout eggs are sensitive to mechanical shock at all times during development (Leitritz and Lewis 1980). Typically, CCV steelhead and salmon eggs are larger than trout eggs, and are likely more sensitive to disturbance than trout eggs. While state angling regulations have moved towards restrictions on selected sport fishing to protect listed fish species, hook and release mortality of steelhead and trampling of redds by wading anglers may continue to cause a threat.

2.6.6. Agricultural Practices

Non-Federal actions that may affect the action area include ongoing agricultural activities in the Sacramento River watershed. Farming and ranching activities within or adjacent to or upstream of the action area may have negative effects on water quality due to runoff laden with agricultural chemicals. Stormwater and irrigation discharges related to agricultural activities contain numerous pesticides and herbicides that may adversely affect salmonid reproductive success and survival rates (King *et al.* 2014). Grazing activities from cattle operations can degrade or reduce suitable critical habitat for listed salmonids by increasing erosion and sedimentation as well as introducing nitrogen, ammonia, and other nutrients into the watershed, which then flow into the receiving waters of the associated watersheds. Agricultural practices in the Sacramento River may adversely affect riparian and wetland habitats through upland modifications of the watershed that lead to increased siltation or reductions in water flow.

2.6.7. Global Climate Change

The world is about 1.3°F warmer today than a century ago, the latest computer models predict that, without drastic cutbacks in emissions of carbon dioxide, and other gases released by the burning of fossil fuels, the average global surface temperature may rise by two or more degrees in the 21st century (IPCC 2001). Much of that increase likely will occur in the oceans, and evidence suggests that the most dramatic changes in ocean temperature are now occurring in the Pacific (Noakes 1998). Using objectively analyzed data Huang and Liu (2000) estimated a warming of about 0.9°F per century in the Northern Pacific Ocean.

Sea levels are expected to rise by 0.5 to 1.0 meters in the northeastern Pacific coasts in the next century, mainly due to warmer ocean temperatures, which lead to thermal expansion much the same way that hot air expands. This will cause increased sedimentation, erosion, coastal flooding, and permanent inundation of low-lying natural ecosystems (*e.g*., salt marsh, riverine, mud flats) affecting listed salmonid and green sturgeon PCEs. Increased winter precipitation, decreased snow pack, permafrost degradation, and glacier retreat due to warmer temperatures will cause landslides in unstable mountainous regions, and destroy fish and wildlife habitat, including salmon-spawning streams. Glacier reduction could affect the flow and temperature of rivers and streams that depend on glacier water, with negative impacts on fish populations and the habitat that supports them.

Summer droughts along the South Coast and in the interior of the northwest Pacific coastlines will mean decreased stream flow in those areas, decreasing salmonid survival and reducing water supplies in the dry summer season when irrigation and domestic water use are greatest. Global warming may also change the chemical composition of the water that fish inhabit: the amount of oxygen in the water may decline, while pollution, acidity, and salinity levels may increase. This will allow for more invasive species to overtake native fish species and impact predator-prey relationships (Peterson and Kitchell 2001, Stachowicz *et al.* 2002).

In light of the predicted impacts of global warming, the CV has been modeled to have an increase of between +2ºC and +7ºC by 2100 (Dettinger *et al.* 2004, Hayhoe *et al.* 2004, Van Rheenen *et al.* 2004, Stewart 2005), with a drier hydrology predominated by rainfall rather than snowfall. This will alter river runoff patterns and transform the tributaries that feed the CV from a spring and summer snowmelt dominated system to a winter rain dominated system. It can be hypothesized that summer temperatures and flow levels will become unsuitable for salmonid survival. The cold snowmelt that furnishes the late spring and early summer runoff will be replaced by warmer precipitation runoff. This will truncate the period of time that suitable cold-water conditions exist downstream of existing reservoirs and dams due to the warmer inflow temperatures to the reservoir from rain runoff. Without the necessary cold-water pool developed from melting snow pack filling reservoirs in the spring and early summer, late summer and fall temperatures downstream of reservoirs, such as Lake Shasta, could potentially rise above thermal tolerances for juvenile and adult salmonids (*i.e.* winter-run Chinook salmon and steelhead) that must hold and/or rear downstream of the dam over the summer and fall periods.

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.

2.7.1. Summary of the Status of the Species and Critical Habitat

Populations of SR winter-run and CV spring-run Chinook salmon and CCV steelhead in California have declined drastically over the last century. The current status of listed anadromous fish species has not significantly improved since the species' most recent status reviews (NMFS 2015, 2016a, 2016b, 2016c, SWFSC 2022). The SR winter-run Chinook salmon ESU is constrained to a single population and a concentrated spawning area, which are both susceptible to drought and fluctuating temperatures. The CV spring-run Chinook salmon and CCV steelhead ESUs are constrained by small population sizes and altered habitat that is susceptible to climate change. If measures are not taken to reverse these trends, the recovery and survival potential of SR winter- run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead will continue to worsen. 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. 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 2018). The critical habitat for all listed fish species in the action area are degraded from their historical conditions, but are still considered critically important to the recovery and conservation of the species for which they were designated.

2.7.2. Summary of the Environmental Baseline and Cumulative Effects

The action area encompasses the Tisdale Bypass, including the Tisdale Weir and the Sacramento River where it intersects with the weir at river mile 119. The action area is considered an important rearing and migratory corridor for all ESA-listed anadromous fish species. Upstream migrating adult sDPS green sturgeon and salmonids may be pushed into the Tisdale Bypass during Tisdale Weir overtopping events or by entering through the Sutter Bypass.

During non-flood conditions, fish passage connectivity to the Sacramento River at Tisdale Weir does not currently exist, which contributes to stranding in this area. Juvenile salmonids and sDPS green sturgeon may enter the bypass if their migration down the Sacramento River coincides with a weir overtopping event. Both adult and juvenile salmonids and sturgeon have the potential to become stranded in the stilling basin of the Weir and in nearby scour channels and ponds as floodwaters recede following overtopping events. Listed fish trapped in the shallow waters of the stilling basin and scour channels are vulnerable to poaching, poor water quality, predation, and receding water levels, leading to death

Continuing activities described in the environmental baseline and cumulative effects sections include agricultural practices, bank stabilization projects, and recreational boating and fishing which are expected to continue to negatively affect the federally listed anadromous fish species in the action area. The impacts described in the cumulative effects section are also expected to further diminish the functional value of critical habitat for the conservation of the species within the action area. For instance, increased demands for water, whether for agricultural purposes or for domestic consumption are expected to continue in the action area, resulting in diminished flows in the river and contributing to higher water temperatures, increased competition for prey and/or cover, and more frequent interactions with predators, all leading to reduced growth and survival. Runoff from agricultural activities may contain contaminants such as pesticides, sediments, and nutrients that may affect listed species through lethal and sublethal impacts. Levee construction and bank protection can reduce floodplain connectivity, change substrate size, and decrease riparian habitat and shaded riverine aquatic cover. Regional urban development is also expected to continue, although the rate of development may slow due to economic pressures in the area. Therefore, the demand for domestic and municipal water supplies diverted from the Sacramento River Basin are expected to increase to meet these demands in future years, although the rate of increase may be moderate in the near term due to economic trends. As urban development increases in the area, the ability to modify or enhance riparian habitat conditions will be diminished in response to flood management needs for urbanized areas. This circumstance will perpetuate the already degraded status of the critical habitat in the action area and reduce the potential for future environmental restoration actions such as setback levees or flood benches along the river channels.

2.7.3. Summary of the Project Effects to Listed Species

The proposed action is expected to affect adult and juvenile SR winter-run Chinook salmon, CV spring-run Chinook salmon, and CCV steelhead, and sDPS green sturgeon. The project is expected to result in the harassment, injury or death, and predation-related mortality of individuals.

Turbidity changes that are within the Central Valley Regional Water Quality Control Board standards would result in sudden localized turbidity increases that would injure juvenile salmonids and sturgeon by temporarily impairing their migration, rearing, feeding, or sheltering behavior. Project-related turbidity increases would also contribute to the susceptibility of juvenile salmonids and sturgeon to increased predation. Turbidity-related injury and predation will be minimized by implementing the avoidance and contingency measures of the SWPPP, and by scheduling in-water work to avoid peak migration periods of listed anadromous salmonids and sturgeon.

Pile driving would result in injury or death to out-migrating juveniles that pass within close proximity. Pile driving is also expected to result in temporary disruptions in the feeding, sheltering, and migratory behavior of adult and juvenile salmon, steelhead, and green sturgeon in the action area. This disruption would result in reduced growth and increased susceptibility to predation. Adults are not expected to be injured or killed, however will likely experience temporary migration delays that is not expected to prevent successful spawning. Pile driving is also not expected to prevent salmonids and sturgeon from passing upstream or downstream, because pile driving will not be continuous through the entire day, and will not occur at night, when the majority of fish migrate.

Operation of the 50-year project is expected to provide improved habitat connectivity for listed fish species to migrate between the Sacramento River and the Sutter Bypass. This enhanced habitat connectivity is expected to improve the ability of anadromous fish to access the Sutter Bypass, potentially resulting in increased growth, and decreased stranding events, thereby reducing the necessity and frequency of fish rescue efforts, increasing individual fitness and survival, and, potentially, contributing to increased spawning success of fish that may have otherwise perished from stranding.

NMFS has considered the potential effects of the project on listed SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon, combined with other activities occurring in the action area, and NMFS determined that the project is not expected to appreciably reduce the likelihood of both the survival and recovery of these species in the wild by reducing their numbers, reproduction, or distribution. This conclusion is also based on the fact that the overall effect of implementing the project will be beneficial to the listed species by improving fish passage.

2.7.4. Summary of Project Effects to Critical Habitat

Critical habitat has been designated for SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon within the action area. Relevant PBFs of the designated critical habitats are listed above in section 2.5.2. Based on the effects of the proposed project described previously in this opinion, the impacts are expected to permanently degrade a small portion of designated critical habitat for all species, increase successful passage through a previous barrier, as well as significantly reduce fish stranding occurrences. The small amount of permanent effects to critical habitat are expected to be offset entirely by the benefits of the project, and result in an overall increase in survival of adults and juveniles in the action area.

The quality of the current conditions of PBFs in the action area are poor compared to historical conditions (pre-levees and weir). In particular, levees, riprapping, and removal of riparian vegetation have greatly diminished the value of the aquatic habitat in the action area by decreasing rearing area, food resources via food-web degradation, and complexity and diversity of habitat forms necessary for holding and rearing (channel diversity). Perpetuating the in-water structure would contribute to the degradation of designated critical habitat. The temporary construction impacts to designated critical habitat would negatively affect the ability of listed species to use the action area as rearing habitat and as migratory corridors during the overlap of migration periods and construction, as discussed in the effects to species section.

Based on the analysis of available evidence, the project is likely to temporarily negatively affect and permanently modify a small portion of the critical habitat for sDPS green sturgeon, CCV steelhead, SR winter-run Chinook salmon, and CV spring-run Chinook salmon, but it is not likely to appreciably diminish the value of designated critical habitat for the conservation of the species. Implementation of the project is expected to provide long-term improvements to rearing and migratory PBFs of sDPS green sturgeon, CCV steelhead, SR winter-run Chinook salmon, and CV spring-run Chinook salmon through the addition of a passage facility. The facility will increase the value in the area for migratory corridors and juvenile rearing habitat by allowing volitional passage, reduced stranding, reduced poaching, and overall increased chances of survival. In a more general sense, this project is expected to increase the overall habitat value for all ESA-listed anadromous fish species in the action area by enhancing habitat connectivity, fish passage, and the overall access to floodplain rearing habitat in the Sutter Bypass.

2.7.5. Risk to Listed ESUs/DPSs and Critical Habitat at the Designation Scale

Based on the geographical location of the action area, a large proportion of the Core 1 and 2 populations of listed salmonids in the Central Valley is expected to be affected by the proposed action. The overall proportion of each population exposed to project area and associated effects during construction are expected to be relatively low. The combination of the selected work window, use of cofferdams, and other proposed avoidance and minimization measures will reduce both the overall number of fish present, and the severity of effects to those that may be present.

As described above, the risk to each species 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.

The Sacramento River portion of the action area is the main adult and juvenile migratory corridor for most of the established spring-run, steelhead, and green sturgeon populations within the Central Valley, so any reduction in habitat quality can be highly detrimental to the entire

ESU/DPS. For SR winter-run Chinook, the ESU is entirely composed of one population, so the effects and risks associated with the proposed action at the population level, also represent the risks at the ESU level. Green sturgeon similarly have very geographically limited distribution to their DPS currently, so effects to a population are very similar to those of the whole DPS.

Continued blockage of access to historical floodplain habitat is a stressor that will continue with implementation of proposed action, which will reinforce the Tisdale Weir to ensure its continued existence. However, the overall effects caused by the perpetuation of the weir and associated structures are significantly reduced by the addition of a fish passage structure. The fish passage structure is expected to significantly reduce fish stranding within the bypass, and increase access back to natal spawning grounds for fish within the Tisdale and Sutter Bypass during flood conditions. The ability for adult and juvenile fish to volitionally return back into their natal waterways removes the majority of the detrimental effects currently caused by the Tisdale Weir.

Construction-related effects would last for the entirety of each work season, but would not permanently modify overall habitat function, with associated noise and turbidity subsiding after construction ends. The presence of the structure and loss of both in-water and riparian habitats will continue into the foreseeable future, thus creating a minor perpetual source of predation and habitat quality impacts (both beneficial and adverse, see Section 2.5) to the action area, and a permanent adverse effect to rearing and migratory PBFs. As the current areas within the bypass provide poor overall rearing habitat with minimal riparian vegetation persisting when the bypass is inundated, the current value of this habitat for rearing is already very low. The habitat in the area is incredibly high value as a migratory corridor for all species, which will have temporary negative PBF effects during construction. Post construction, the value of the habitat with the addition of volitional passage, will be exponentially higher for both migration and rearing purposes.

The addition of a fish passage facility into the Tisdale Weir will result in an overall improvement to the PBFs of migratory corridors, and fulfill a recovery action for salmonids and green sturgeon. Providing passage through the Sutter Bypass is a priority 1 recovery action in NMFS 2014, as well as a high priority recovery action for green sturgeon (NMFS 2018).

Combining the adverse and beneficial effects associated with the proposed action described above, including the environmental baseline, cumulative effects, status of the species, and critical habitat, the project is not expected to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing their numbers, reproduction, or distribution; or appreciably diminish the value of designated critical habitat 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 cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, or sDPS 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 interim 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.

The incidental take exemption conferred by this incidental take statement is based upon the proposed action occurring as described in the biological opinion and in more detail in the action agency's biological assessment.

2.9.1. Amount or Extent of Take

In this BO, NMFS determined that the project is reasonably certain to result in the incidental take of individual SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, and sDPS green sturgeon. Incidental take associated with this project is expected to be in the form of mortality, harm, or harassment of both juveniles and adults of all the aforementioned listed species during both the construction and O&M of the new facilities.

Incidental take during construction activities in the action area is expected to occur due to increased turbidity, underwater noise, increased vulnerability to predation, and restricted access to nearshore riparian habitat along the East bank of the Sacramento River. Incidental take of listed fish species is expected to occur due to the dewatering of the construction site for the intake channel, the weir structural repairs, and the fish passage facility.

Incidental take in the form of injury, mortality, harm, or harassment, of low numbers of juvenile SR winter-run and CV spring-run Chinook salmon, as well as both individual adults and juveniles of the CCV steelhead and sDPS green sturgeon populations, are expected to occur as a result of construction activities occurring over an approximately 7-month period from April through October, when individuals from these populations may be present in the Sacramento River.

It is not practical to quantify or track the amount or number of individual listed fish that are expected to be incidentally taken per species as a result of the project, due to the variability associated with the response of listed species to the effects of the project, the varying population size of each species, annual variations in the timing of migration, and uncertainties regarding 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 ecological surrogates, and it is practical to quantify and monitor surrogates to determine the extent of incidental take that is occurring.

The most appropriate thresholds for the extent of incidental take that is expected to occur during construction are the following ecological surrogates:

1. the areal and temporal extent of nearshore riparian habitat affected by construction activities along the bank of the Sacramento River and within the Tisdale Bypass (Figure 3 below, provided by DWR/USACE, is the expected acres of impacts, including an additional 10% to account for slight adjustments as needed),

2. the level of acoustic noise in the aquatic environment generated during construction,

3. the extent and duration of turbidity increases in the aquatic environment relative to environmental background conditions during construction. All construction related effects are expected to occur within the described work window, defined for purposes of the ITS as: annually from July 1 through September 30, with a potential to begin work as early as April 30 if water levels are low enough to avoid in-water work.

The analysis of the effects of the project anticipates that construction activities associated with the project will result in:

1. Temporary disturbance to approximately 0.96 acres (up to 1.056 acres) of habitat along the bank of the Sacramento River adjacent to the weir, or habitat will be inaccessible to listed anadromous fish species during the defined work window. Fish response to disturbance/inaccessible riparian cover includes displacement, leading to reduced survival due to predation, and reduced feeding, leading to reduced growth and fitness. Incidental take will be exceeded if temporary project impacts exceed 1.056 acres within the action area of the Sacramento River. See figure 4 for calculations.

2. Approximately 0.28 acres (up to 0.308 acres) of habitat within the Tisdale Bypass being temporarily disturbed, or otherwise inaccessible to listed anadromous fish species during the defined work window. Fish response to inaccessible riparian cover includes displacement, leading to reduced survival due to predation, and reduced feeding, leading to reduced growth and fitness. Incidental take will be exceeded if temporary impacts exceed 0.308 acres within the Tisdale Bypass.

	Areas of Impacts	Acres	Location	Expected	With 10% adjustment
Permanent Impacts	Fish Collection Basin	1.34	Tisdale	1.41	1.551
	Basin Access Ramp	0.02			
	Bridge Piers	0.05			
	Connection Channel	0.12	Sacramento	0.29	0.319
	Maintenance Road	0.17			
Temporary Impacts	Parking lot to weir transition	0.32	Sacramento	0.96	1.056
	Upstream Landing	0.57			
	Connection Channel Revetment	0.07			
	Basin to Bypass Transition	0.26	Tisdale	0.28	0.308
	Garmire Rd Abutment	0.02			

Figure 4. Expected temporary and permanent effects to critical habitats with a calculated 10% "buffer" to account for slight adjustments

3. Approximately 0.29 acres (up to 0.319 acres) of habitat along the bank of the Sacramento River being permanently replaced with hardened substances such as concrete or riprap and no longer providing riparian habitat to listed anadromous fish. Fish response to inaccessible riparian cover includes displacement, leading to reduced survival due to predation, and reduced feeding, leading to reduced growth and fitness. Incidental take will be exceeded if permanent impacts exceed 0.319 acres within the action area of the Sacramento River.

4. Approximately 1.41 acres (up to 1.551 acres) of habitat within the Tisdale Bypass being permanently replaced with hardened substances such as concrete or riprap and no longer providing riparian habitat to listed anadromous fish. Fish response to inaccessible riparian cover includes displacement, leading to reduced survival due to predation, and reduced feeding, leading to reduced growth and fitness. Incidental take will be exceeded if permanent impacts exceed 1.551 acres within the Tisdale Bypass.

5. listed anadromous fish salvage and relocation efforts following dewatering of approximately 0.072 acres (up to 0.0792 acres) of the bank of the Sacramento River adjacent to Tisdale Weir where the fish passage facility is being constructed. Fish response to salvage and relocation efforts includes handling stress, possible injury, possible death, and increased susceptibility to predation, leading to reduced fitness and survival. Incidental take will be exceeded if dewatering for construction occurs in an area larger than 0.0792 acres.

6. acoustic noise generated in the aquatic environment from impact and vibratory pile driving, and other construction activities that exceeds typical ambient background conditions in the Sacramento River and Tisdale Bypass. Activities will affect adults and juveniles through direct stress, injury, or death. Activities may also cause harm through displacement, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Incidental take will be

exceeded if the single strike criteria exposure; a SEL of 183 dB re: 1 μPa2 •sec and a peak sound pressure of 206 decibels (dB) (re: 1 micropascal [μPa]) as measured 10 m from the source is exceeded.

7. increases to the ambient background levels of turbidity in the aquatic environment downstream from the construction site on the Sacramento River. Fish response to increased turbidity includes displacement, decreased feeding, and increased predation. Based on the types of vehicles and equipment to be used, the methods described for construction, the increases in turbidity above ambient background conditions are not expected to exceed beyond the following levels when measured no further than 1,000 feet downstream of the of the active in-water work area. Therefore, incidental take will be exceeded if turbidity measurements 1,000 feet downstream of active work exceed the following:
    - Where natural turbidity is between 5 and 50 nephelometric turbidity units (NTU), project-related turbidity increases are expected to be elevated up to 20 percent above ambient conditions.
    - Where ambient conditions are between 50 and 100 NTU, project-related turbidity is expected to increase up to 10 NTU.
    - Where natural turbidity is greater than 100 NTU, project-related turbidity would be up to 10 percent increase.

The analysis of the effects of the project anticipates that long-term operation and maintenance of the Tisdale Weir and fish passage structure will result in:

1. harm, injury and death to listed fish, due to operations (including debris blockages, gate failure, and standard operations as described in the proposed action) of the fish passage facility. Standard operations also includes adaptive management to allow flexibility to O&M, which requires coordination and written concurrence from NMFS and CDFW for authorization. Activities will affect juveniles and adults through increased stress, injury, or death. Harm is also expected through displacement, passage delay, increased predation, and loss of food, resulting in decreased fitness, growth, and survival. Take will be exceeded if operations vary outside of the described O&M or vary outside of NMFS- and CDFW-approved adaptively managed activities. Further, take will also be exceeded if adaptively managed activities do not receive prior written authorization from both NMFS and CDFW.

2. the temporary loss of up to 7.2 acres of rearing habitat within the action area through operations and maintenance activities. Activities are expected to cause temporary disturbance, increased suspended sediment, or inaccessible areas to listed fish. Fish response to inaccessible riparian cover includes displacement, leading to reduced survival due to predation, and reduced feeding, leading to reduced growth. Incidental take will be exceeded if annual temporary effects within the action area exceed 7.2 acres.

3. listed anadromous fish salvage and relocation efforts following dewatering of up

to 0.072 acres of habitat within the action area for maintenance activities. Fish response to salvage and relocation efforts includes handling stress, possible injury, possible death, and increased susceptibility to predation, leading to reduced fitness and survival. Incidental take will be exceeded if dewatering for maintenance occurs in an area larger than 0.072 acres.

4. the permanent loss of up to 0.13 acres of habitat within the action area through the placement of rock revetment for maintenance activities during the defined work window. Fish response to inaccessible riparian cover includes displacement, leading to reduced survival due to predation, and reduced feeding, leading to reduced growth. Incidental take will be exceeded if permanent effects within the action area exceed 0.13 acres over the life of the structure.

5. harm, injury and death to listed fish, due to fish stranding, rescue, and relocation within the Tisdale 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. Incidental take will be exceeded if more than 2% of any listed fish species handled annually are directly killed due to handling subsequent to stranding.

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

(1) USACE/DWR shall minimize impacts to listed species and their critical habitats from project specific activities.

(2) USACE/DWR shall take measures to ensure development and implementation of all monitoring, long term operations, and adaptive management plans as detailed in the BA.

(3) USACE/DWR shall take measures to ensure that contractors, construction workers, and all other parties involved with this project implement the project as proposed in the biological assessment and this BO.

(4) USACE/DWR shall take measures to monitor and report incidental take of listed fish during construction or operations discussed in this BO.

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:

    a) USACE/DWR shall monitor surface water quality by measuring turbidity no further than 1,000 feet downstream from active construction sites at a depth approximately two thirds of the total water depth. Turbidity measurements shall be taken twice daily during construction activities, and any increases shall not exceed the CVRWQCB standard as described in the proposed action.

    b) USACE/DWR shall ensure the action area within Tisdale Bypass is constructed and maintained to minimize stranding of fish though grading or construction of drainage channels as applicable.

    c) USACE/DWR shall notify NMFS and CDFW by email prior to work extending past 7pm. Additional minimization measures may then be recommended by NMFS and CDFW for nighttime work activities.

    d) USACE/DWR shall use vibratory hammers for pile driving as often as feasible to reduce impacts to aquatic species. Attenuation measures shall be used during impact pile driving to control and dampen underwater pressure wave propagation. Effective attenuation measures include:
        - Use of a bubble curtain around the pile.
        - Use of a dual-casing isolation system.
        - Use of a cushion block between the hammer and the pile.
        - Pile driving shall not be conducted at night when migration is most prevalent

    e) USACE/DWR shall complete preparation of a comprehensive fish rescue and salvage plan in coordination with NMFS and CDFW, providing detailed descriptions of procedures and gear types to be employed for fish relocation and dewatering efforts prior to the commencement of any construction activities associated with this project, or future fish rescue and relocation activities.

    f) USACE/DWR shall notify NMFS and CDFW within 24 hours, by phone or email, regarding any large debris blockages or other issues that substantially reduce fish passage.

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

a) Every 5 years hereafter, USACE/DWR shall provide a report to NMFS and CDFW, which shall include, but is not necessarily limited to, evaluating the effectiveness of the Tisdale Weir Fish Passage Project (project) achieving its: biological objectives and performance goals; operational criteria; and associated monitoring.

b) USACE/DWR shall ensure the long-term O&M plan for the Tisdale Weir and new fish passage facility is developed in coordination with NMFS and CDFW. The plan shall include, but not limited to: post-project monitoring of fish stranding, measures to reduce stranding and passage delays, amended operations changed through adaptive management protocols.

3. The following terms and conditions implement reasonable and prudent measure 3:

a) USACE/DWR shall provide a copy of this BO, associated BA, and other relevant 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 requirements of this BO. A notification that contractors have been supplied with this information will be provided to the reporting address below.

b) A NMFS and CDFW-approved worker environmental awareness training program for construction personnel shall be conducted by the 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 listed fish species, 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 BO, associated BA, and other relevant documentation. Written documentation of the training must be submitted to NMFS and CDFW within 30 days of the completion of training.

4. The following terms and conditions implement reasonable and prudent measure 4:

a) USACE/DWR shall ensure the action area is surveyed every year after overtopping events and repair any large scour holes or erosion that may cause stranding or increase the likelihood of stranding within the Tisdale Bypass.

b) USACE/DWR shall submit an annual report to NMFS and CDFW of any incidental take that occurs as part of the initial construction, or during future operations, maintenance, or monitoring activities. This report shall be submitted no later than August 31 of each year.

c) USACE/DWR shall provide NMFS and CDFW a detailed annual report for the Tisdale Weir and new fish passage facility by August 31 of each year. The report shall include: operations for the past year, summary of water conditions and overtopping events, fisheries monitoring completed, results of monitoring, and also any repairs or maintenance done.

d) Within 30 days of completing construction activities associated with the project, USACE/DWR shall submit a report to NMFS and CDFW describing the work that was performed, the starting and ending dates of the construction activities, any observed adverse effects to aquatic habitats and their duration (*i.e.*, increased suspended sediment levels or turbidity, instances of pollution, unusual animal behaviors in adjacent waters, etc.), or any other problems encountered during construction activities.

e) Any SR winter-run Chinook salmon, CV spring-run Chinook salmon, CCV steelhead, or sDPS green sturgeon found dead or injured within the action area during construction shall be reported within 48 hours to NMFS and CDFW via email or by phone. Any dead specimen(s) should be placed in a cooler with ice and held for pick up by an individual designated to do so.

f) All reports for NMFS shall be sent preferably by email to:

Assistant Regional Administrator
National Marine Fisheries Service
California Central Valley Office
650 Capitol Mall, Suite 5-100
Sacramento California 95814-4607
Email: 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/DWR should support and promote aquatic and riparian habitat restoration in the Sacramento River basin for listed aquatic species. Practices that avoid or minimize negative impacts to listed species should be encouraged.

2) USACE/DWR should continue to look for opportunities to restore floodplain habitat on the Sacramento River basin.

3) USACE/DWR should continue to work cooperatively with other State and Federal agencies, private landowners, governments, and local watershed groups to identify opportunities for cooperative analysis and funding to support salmonid habitat restoration projects.

4) USACE/DWR should use species recovery plans to help ensure that their actions will address the underlying processes that limit fish recovery, and to identify key actions in the action area when prioritizing project sites each year.

2.11. Reinitiation of Consultation

This concludes formal consultation for the Tisdale Weir Rehabilitation and Fish Passage Project.

Under 50 CFR 402.16(a): "Reinitiation of consultation is required and shall be requested by the Federal agency or by the Service where discretionary Federal agency 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 physical, biological, and chemical 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 on EFH may result from actions occurring within EFH or outside of it and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810). Section 305(b) 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 [CFR 600.905(b)].

This analysis is based, in part, on the EFH assessment provided by the USACE and descriptions of EFH for Pacific Coast salmon (PFMC 2014) contained in the fishery management plans developed by the PFMC and approved by the Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Project

The geographic extent of salmon freshwater EFH is described as all water bodies currently or historically occupied by PFMC managed salmon within the USGS 4th field hydrologic units identified by the fishery management plan (PFMC 2014). This designation includes the Sacramento River for all runs of Chinook salmon that historically and currently use these watersheds (winter-run, spring-run, fall-run, and late fall-run). The Pacific Coast salmon fishery management plan also identifies Habitat Areas of Particular Concern (HAPCs): complex channel and floodplain habitat, spawning habitat, thermal refugia, estuaries, and submerged aquatic vegetation, of which the HAPC for complex channel and floodplain habitat are expected to be either directly or indirectly adversely affected by the proposed action

3.2. Adverse Effects on Essential Fish Habitat

Effects to Pacific Coast salmon HAPCs for complex channel and floodplain habitat are discussed in the context of effects to critical habitat PBFs as designated under the ESA and described in section 2.5.2. A list of adverse effects to EFH HAPCs is included in this EFH consultation. The effects are expected to be similar to the impacts affecting critical habitat and include the following: sediment and turbidity, in-channel disturbance from pile driving, and permanent habitat loss/modification.

Sediment and turbidity

- Degraded water quality
- Reduction/change in aquatic macroinvertebrate production

In-channel disturbance from pile driving and in-water work

- Channel disturbance and noise pollution from pile driving activity and associated piles

Permanent and Temporary habitat loss/modification

- Reduced shelter from predators
- Reduction/change in aquatic macroinvertebrate production
- Reduced habitat complexity

3.3. Essential Fish Habitat Conservation Recommendations

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

1) USACE should recommend to contractors to use biodegradable lubricants and hydraulic fluid in construction machinery. The use of petroleum alternatives can greatly reduce the risk of contaminants from directly or indirectly entering the aquatic ecosystem.

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.

3.4. Statutory Response Requirement

As required by section 305(b)(4)(B) of the MSA, the 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)].

In response to increased oversight of overall EFH program effectiveness by the Office of Management and Budget, NMFS established a quarterly reporting requirement to determine how many conservation recommendations are provided as part of each EFH consultation and how many are adopted by the action agency. Therefore, we ask that in your statutory reply to the EFH portion of this consultation, you clearly identify the number of conservation recommendations accepted.

3.5. Supplemental Consultation

The 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 United States Army Corps of Engineers (USACE). Other interested users could include the California Department of Water Resources (DWR). Individual copies of this opinion were provided to the USACE and DWR. 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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