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 #: WCRO-2021-02625

February 8, 2022

Mr. Robert Blizard
Branch Chief
Office of Biological Sciences and Permits, District 4, Caltrans
P.O. Box 23660
Oakland, California 94623-5903

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Miner Slough Bridge Replacement Project Reinitiation 2021

Dear Mr. Blizard:

Thank you for your letter of September 24, 2021, requesting reinitiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 *et seq.*) for the Miner Slough Bridge Replacement Project (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.

Based on the best available scientific and commercial information, the biological opinion concludes that the Miner Slough Bridge Replacement Project is not likely to jeopardize the continued existence of the federally listed threatened Central Valley (CV) spring-run Chinook salmon evolutionarily significant unit (ESU) (*Oncorhynchus tshawytscha*), threatened California Central Valley (CCV) steelhead distinct population segment (DPS) (*O. mykiss*), endangered Sacramento River (SR) winter-run Chinook salmon (*O. tshawytscha*) or the threatened southern DPS (sDPS) of North American green sturgeon (*Acipenser medirostris*) and is not likely to destroy or adversely modify the designated critical habitats of the above species. NMFS has included an incidental take statement with reasonable and prudent measures and terms and conditions that are necessary and appropriate to avoid, minimize, or monitor incidental take of listed species associated with the Project. This reinitiated biological opinion replaces the original and thus the original 2016 biological opinion is no longer in effect.

NMFS recognizes that Caltrans has assumed the Federal Highway Administration's (FHWA) responsibilities under Federal environmental laws for this project as allowed by a Memorandum of Understanding (National Environmental Policy Act Assignment) with the FHWA effective December 23, 2016. As such, Caltrans serves as the lead Federal Action Agency for the proposed project.

NMFS also reviewed the likely effects of the proposed action on essential fish habitat (EFH), pursuant to section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act [MSA; 16 U.S.C. 1855(b)]. We have included the results of that review in Section 3 of this document, which includes EFH Conservation Recommendations. As described in greater detail in that section, as required by section 305(b)(4)(B) of the MSA, Caltrans must provide a detailed response in writing to NMFS within 30 days after receiving an EFH Conservation Recommendation.

Please contact Lyla Pirkola in NMFS California Central Valley Office via email at lyla.pirkola@noaa.gov or via phone at (916) 930-5615 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- WCR2016-SA00244
151422-WCR2021-SA00124

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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

Miner Slough Bridge Replacement Project Reinitiation 2021

NMFS Consultation ECO Number: WCRO-2021-02625

Action Agency: California Department of Transportation

Affected Species and NMFS' Determinations: NA = Not Applicable

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 (*Oncorhynchus tshawytscha*) evolutionarily significant unit (ESU)	Threatened	Yes	No	Yes	No
Sacramento River winter-run Chinook salmon (*Oncorhynchus tshawytscha*) ESU	Endangered	Yes	No	NA	NA
California Central Valley steelhead (*Oncorhynchus mykiss*) distinct population segment (DPS)	Threatened	Yes	No	Yes	No
Southern DPS of North American green sturgeon (*Acipenser medirostris*)	Threatened	Yes	No	NA	NA

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: February 8, 2022

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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 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 NMFS California Central Valley Office in Sacramento, California.

1.2. Consultation History

- On January 15, 2016, the NMFS West Coast Region – California Central Valley Office received a consultation initiation request and Biological Assessment (BA) for the Miner Slough Bridge Replacement Project. Listed species and critical habitats in the Action Area include CCV steelhead and their critical habitat; CV spring-run Chinook salmon and their critical habitat; SR winter-run Chinook salmon and their critical habitat; and sDPS green sturgeon and their critical habitat.
- On May 9, 2016, NMFS requested additional information from Caltrans regarding avoidance and minimization measures to be implemented with the project.
- On May 26, 2016, NMFS received additional information on avoidance and minimization measures to be implemented with the project.
- On May 26, 2016, NMFS initiated formal ESA Section 7 consultation.
- On May 31, 2016, NMFS received information regarding geotechnical drilling associated with the project.
- On June 20, 2016, NMFS issued a biological opinion for the project.
- On March 25, 2021, NMFS received information that additional geotechnical drilling will be required.
- On September 24, 2021, NMFS received a biological opinion amendment package and the request to amend the 2016 biological opinion.
- On October 7, 2021, NMFS explained to Caltrans via email that reinitiation would be warranted, since the proposed project changes result in effects to species in excess of what was described in the 2016 BO.

- On October, 12, 2021, NMFS and Caltrans met to discuss project changes and the reinitiation process. Caltrans agreed to change their request to a request for reinitiation of consultation. Reinitiation of formal consultation occurred at that time.

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). 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). We considered, under the ESA, whether or not the proposed action would cause any other activities and determined that it would not.

Project Description
Caltrans is proposing to replace the existing Miner Slough Bridge. The new bridge would be constructed on a new alignment with improvements, such as lanes and shoulders of standard width, standard vertical clearance, and flares at each end to provide extra width for truck-turning movements. A new four-span fixed bridge is proposed to be constructed approximately 100 feet (ft) west of the existing alignment. The new bridge will have standard features with a 12 ft lane and an 8 ft shoulder in each direction. The Project proposes to maintain the existing vertical clearance over the slough. The Project would also require construction of temporary trestles to be used during construction. Route 84 will also be realigned for a length of about 900 ft north of Holland Road.

Existing Bridge
The existing bridge was built in 1933, and is 18 ft wide and accommodates one lane of traffic in either direction. It is a swing bridge with non-standard features and very low annual average daily traffic (336 vehicles in 2011). The existing bridge is 367 ft long and is composed of three sections with timber plank decks and a 2-inch-thick asphalt concrete wearing surface. The 191 ft center steel truss swing span is on a reinforced concrete (RC) cylindrical swing pier, with RC rest piers. The two approach spans are made of timber stringers on timber cap-and-pile bents with abutments of RC on timber piles.

Staging Areas and Access Roads
Staging will occur in the area between the existing alignment and the new alignment to the north of the bridge (Figure 1). This 1.6-acre (ac) area will be cleared by the construction contractor for staging and preparation of the new SR 84 alignment. Traffic coordination and limited closures of the existing bridge for construction of trestles, as well as conforming of the approach spans of new bridge to highway lanes, may be necessary. The existing bridge will continue to be used for traffic during construction.

Roadway Realignment
A section of SR 84 immediately north of the bridge will be permanently realigned for a stretch of approximately 900 ft, where it will conform to the existing highway. This realignment will have standard 12 ft lanes with 8 ft paved shoulders. The roadway footprint will range between 43 and 142 ft. An approximately 570 ft-long section of the existing SR 84 at Holland Road will be widened to accommodate truck turns. After SR 84 is realigned the old section will be removed.

Holland Road on top of the levee will be widened for a stretch of approximately 340 ft in the vicinity of the new bridge. On the south side of the levee facing the slough Holland Road levee, work will extend out 8 to 10 ft from the edge of existing pavement, and approximately 78 ft from the edge of existing pavement on the north side of Holland Road. Ryer Road will be widened for a stretch of approximately 417 ft in the vicinity of the new bridge. The levee work will extend out approximately 15 ft from edge of pavement on the north side (slough side) and approximately 27 ft from the edge of pavement on the south side. The unpaved access road extending from the old Highway (84) to the staging area is currently 18 to 20 ft wide. This access road will be widened to 24 ft.

Temporary Trestle Bridge Construction and Removal

Two temporary trestles will be installed on each end of the bridge to facilitate bridge construction. The one on the south end will be approximately 86 ft long and the other on the north end will be about 204 ft long. This will leave an opening of about 85 ft for boat traffic navigation between the two trestles. Each trestle will be a width of 35 ft with a superstructure of timber decking, steel stringers, and steel pipe piles. The bents will be spaced approximately 25 to 40 ft apart, with piles within a bent 5 to 10 ft apart. The estimated number of piles within Miner Slough is 92, with each being approximately 50 to 75 ft long and 3 ft in diameter (Table 1). The estimated area of temporary impacts to aquatic areas from the piles is about 650 square ft, and temporary fill in aquatic areas will total about 3.14 cubic yards in the tidal wetland and 314.0 cubic yards in Miner Slough.

The piles will be installed by vibrating them as deeply as possible, then driving them to the desired elevation. Once construction is complete and the old bridge is removed, the temporary trestles will be removed, and the area will be restored. Barges may be used to facilitate construction of the new bridge and demolition of the old bridge. The temporary trestle pipe pile will either be vibrated out or cut off 3 ft below the mudline. Any existing void will either be backfilled with clean sand and gravels (native material), or be allowed to fill in naturally.

New Pipe Pile Piers

The Project includes the installation of six 5-ft-diameter cast-in-steel-shell (CISS) pipe piles arranged in three piers to support the new bridge. Each pier will consist of two piles connected by a concrete pier cap. The Project includes construction of three steel-reinforced cast concrete piers to support the bridge. Pier construction is summarized in Table 1.

Table 1. Pier Construction Parameters

Description	Piers 2, 3, & 4	Temporary Trestle
Number of piles	2 per pier	92
Depth of piles	135 ft	approx. 50 ft
Diameter of pile	5 ft	3 ft
Height of pile/pier above MHW	18 ft	NA
Elevation of top of pier above MHW	25 ft (Piers 2 and 3), 22 ft (Pier 4)	approx. 22 ft

Piers 2 and 3 will be in aquatic areas, while Pier 4 will be immediately adjacent to aquatic areas. For Piers 2, 3, and 4, the piles will be driven using a combination of vibratory and impact hammers, the piles cleaned out, a rebar cage installed, and the piles filled with concrete. Four navigational dolphins, which are structures consisting of piles for the purpose of providing lanes for vessels, will be placed adjacent to Pier 2 and Pier 3 to identify the main channel. The dolphin elements will be vibrated or impact driven into place. The estimated volume of fill in aquatic areas for Piers 2 and 3 is 44 cubic yards. Water depth at Pier 2 is 7 to 9 ft and at Pier 3 is 21 to 22 ft. Total volume of the four pipe piles from MHW to tip of pile (estimated at a total length of 138 ft for the four piles) is 436 cubic yards. The estimated volume of fill in aquatic areas for the dolphins is 15.71 cubic yards. A pile load test will be performed to confirm the load capabilities of the proposed bridge columns. The pile load test will occur approximately 150 to 200 ft north of Miner Slough adjacent to Ryer Avenue, in a location that is outside of critical habitat.

Abutment Foundations
Abutments 1 and 5 will be constructed on the existing levees, above the channel and outside of any wetlands. The abutments will be cast in place with approximate dimensions of 9 ft wide by 100 ft long. Each abutment will be supported by 32 16-inch-diameter pipe piles in two rows. The front row of piles will consist of 20 piles and the back row will consist of 12 piles. A trench approximately 11 ft wide along the face and sides of the abutments may be dug to facilitate construction. Temporary shoring will be used to stabilize the levee. The abutment support piles will be driven in, then the abutments will be cast in place. The abutments of the new bridge structure will be constructed above the high-water elevation and outside of the ordinary high-water mark, but below top of levee.

Bridge Structure
A swing span, steel girder bridge will make up the superstructure of the proposed new bridge. Continuous steel I-girder beams longitudinally connected by cross-frames and diaphragm will provide support from the superstructure down to the piers. The concrete girders will be placed on top of the pier caps to form the deck substructure. Bridge deck forms will then be installed on the girders and the deck cast in place. All of this work is outside of aquatic areas.

Approach Structure
Precast, prestressed concrete I-girders spaced evenly will be mounted on top of the all piers to form the lower part of the superstructure. Between the precast I-girders, forms will be placed to lay out the deck reinforcement as well as curbs, and then the forms filled with concrete. On the south end of the bridge, the approach slab conforms to the edge of the existing highway. On the north end of the bridge, the approach slab is higher by 3 ft at the edge of Holland Road.

Pavement Section
All roadway work is outside aquatic habitat and listed critical habitat. The bridge deck will consist of cast-in-place reinforced concrete. Holland Road will be raised and then paved for approximately 340 ft in the vicinity of the new bridge. Portions of Ryer Road north of the bridge will be rebuilt to conform to the new abutment elevations and existing SR 84 facilities.

Drainage

Roadway drainage systems may be installed along SR 84 on the north and south sides of the new bridge. The drainages will capture roadway runoff and will follow Regional Water Quality Control Board guidelines.

Demolition of Existing Bridge
Demolition of the existing bridge is expected to proceed in the following general sequence. First, the superstructure will be removed either by cutting of the steel members or disassembling of structural elements. The asphalt roadway surface will be ground off and trucked offsite, then the steel beams and stringers removed. The remaining center swing pier will either be cut into pieces or crumbled and removed to 3 ft below mudline. Any existing void will be backfilled with clean sand and gravels (native material) or allowed to fill in naturally. The approach spans will be removed similarly. A cofferdam may be used for the removal of the main pier. The concrete and wooden piles of the approach spans and navigation dolphins will be removed to 3 ft below the mudline. The temporary trestles will be used for the demolition of the existing bridge. Removal of the existing bridge piers will restore 0.012 -acre of aquatic areas. The volume of material removed from Miner Slough will be approximately 239.5 cubic yards.

Borrow and Disposal
The Project will require imported fill material. Material excavated within uplands will either be reused as appropriate or off-hauled. Material excavated from the pipe pile removal activities will be hauled offsite and disposed of in a regulated upland area.

Geotechnical Exploration
Prior to Project implementation, geotechnical boring will be conducted in the action area. Four bore holes are planned with two occurring in-water and two occurring in the adjacent levees outside of the channel. The in-water test bores will be conducted using rotary wash self-casing drilling system. Geotechnical work will be conducted between August 1st and November 30th and will require approximately 12 working days to complete.

Project Schedule
Construction is scheduled to last approximately 2 to 3 years. Out-of-water work may take up to 3 years, potentially starting in April and ending in December, if weather permits and permit conditions are met. Work in the water (to include pile driving associated with the temporary trestles and construction of Piers 2 and 3, as well as in-water demolition of the existing bridge's piers/abutments, and the dolphins) will take place between August 1 and November 30.

Construction Equipment
The equipment used to complete the construction will include the following: excavators, graders, cranes, pile drivers, loaders, forklifts, backhoe, concrete trucks and pumps, pavers, rollers, compactors, air compressors, portable generators, temporary signals, pile driving rigs/diesel hammer, and portable lighting.

1.4. Avoidance and Minimization Measures

Construction Planning
Caltrans will install environmentally sensitive area fencing around the Project limits along the banks of Miner Slough to protect riparian vegetation and elderberry shrubs adjacent to the

Project site. This will prevent the encroachment of construction personnel into sensitive areas not needed for construction of the Project. All construction personnel will attend an environmental education program delivered by a Services-approved biologist prior to working on the Project site. The program will include an explanation of how to best avoid the incidental take of listed species. The field meeting will include topics on species identification, life history, descriptions, and habitat requirements during various life stages. Emphasis will be placed on the importance of the habitat and life stage requirements within the context of Project maps showing areas where avoidance and minimization measures are to be implemented. The program will include an explanation of applicable federal and state laws protecting endangered species, as well as the importance of compliance with Caltrans and various resource agency conditions.

Sedimentation and Turbidity
Caltrans will construct one or more Baker tanks or other settling tanks onsite. Alternative methods may include pumping the water over the levee and allowing the water to filter through riparian vegetation before it re-enters the slough system. If the settling tank method is used, all water removed from the area inside the coffer dam during construction and installation will be pumped into a settling tank until all sediments settle out of the water. This water will then be discharged downstream of the Project area. Caltrans will also construct the coffer dam during low tide as much as possible to reduce the likelihood of a sediment plume washing away downstream. Sediment curtains may also be used outside the coffer dam as it is being installed. These measures will be included in the Project's standard special provisions. Caltrans will also implement several erosion control measures to minimize sediment incursion into the active channel. Such measures will include the use of erosion control blankets, fiber rolls, and silt fences where applicable. All disturbed areas will be hydroseeded or revegetated post construction. Caltrans will hydroseed all disturbed areas between construction seasons. Because of these measures, the effects to the listed species is considered to be insignificant.

Pollution and Hazardous Materials
A Storm Water Pollution Prevention Plan (SWPPP) will be required as part of this Project. The SWPPP will include dedicated fueling and refueling practices. Dedicated fueling areas will be protected from storm water run-on and will be located at least 50 ft from downslope drainage facilities and water courses. Fueling will be performed on level-grade areas only. On-site fueling will only be used when and where it is impractical to send vehicles and equipment off-site for fueling. When fueling must occur onsite, the contractor will designate an area to be used subject to the approval of the Resident Engineer representing Caltrans. Drip pans or absorbent pads will be used during on-site vehicle and equipment fueling. Equipment staging areas will be sited at least 150 ft away from the active channel. A spill response plan is currently in place for geotechnical operations.

Effects to Riparian Vegetation
Approximately 0.09 ac of forested riparian habitat will be permanently lost and 0.162 ac will be temporarily lost as a result of this Project. Riparian habitat loss will result from the bridge span itself and construction of the bridge abutments and temporary trestles. Some riparian habitat loss will be offset through removal of the old bridge and restoration of those areas post-demolition. Caltrans will work with NMFS and the other resource agencies to identify a species palette that will be used to restore all disturbed areas on site. Native grasses, shrubs, and trees will be

included in onsite restoration efforts. Caltrans will also re-contour all areas graded for construction of the trestles; Caltrans will restore the site to pre-project conditions to the extent possible. All vegetation restoration efforts and plans for recontouring the levee will be developed through coordination with the resource agencies and the U.S. Army Corps of Engineers and the Reclamation Districts 501 and 999 who own and operate the levee.

Hydroacoustic Impacts
Pile-driving activities will be restricted to August 1 to November 30. The contractor will be required to use attenuation devices around piles that will be driven in the water. Attenuation devices could take the form of bubble rings or of completely dewatering the cofferdam for the center pier removal of the old bridge.

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 CCV steelhead, CV spring-run Chinook salmon, SR winter-run Chinook salmon, and sDPS green sturgeon 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 biological 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 biological 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 biological 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	Listing Classification and Federal Register Notice	Status Summary
Sacramento River winter-run Chinook salmon ESU	Endangered, 70 FR 37160; June 28, 2005	According to the NMFS 5-year species status review (NMFS 2016c), the status of the 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 winter-run Chinook salmon ESU viability.
Central Valley spring-run Chinook salmon ESU	Threatened, 70 FR 37160; June 28, 2005	According to the NMFS 5-year species status review (NMFS 2016b), the status of the CV spring-run Chinook salmon ESU, until 2015, has 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. Monitoring data showed sharp declines in adult returns from 2014 through 2018 (CDFW 2018).
California Central Valley steelhead DPS	Threatened, 71 FR 834; January 5, 2006	According to the NMFS 5-year 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 in danger of becoming endangered. 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.

Species	Listing Classification and Federal Register Notice	Status Summary
Southern DPS of North American green sturgeon	Threatened, 71 FR 17757; April 7, 2006	According to the NMFS 5-year species status review (NMFS 2015) 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 River. However, the species viability continues to face a moderate risk of extinction because many threats have not been addressed, and the majority of spawning 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).

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 (river mile (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 rangewide critical habitat are significantly limited and degraded, the habitat remaining is considered highly valuable.

Critical Habitat	Designation Date and Federal Register Notice	Description
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 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 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 CCV steelhead critical habitat in the Central Valley are significantly limited and degraded, the habitat remaining is considered highly valuable.

Critical Habitat	Designation Date and Federal Register Notice	Description
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 mainstem 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 Point Dam. 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 also 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. Although the current conditions of PBFs sDPS green sturgeon rangewide critical habitat 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 the rangewide status of the threatened and endangered anadromous fish in the Central Valley and aquatic habitat at large is climate change. Warmer temperatures associated with climate change reduce snowpack and alter the seasonality and volume of seasonal hydrograph patterns (Cohen *et al*. 2000). Central California has shown trends toward warmer winters since the 1940s (Dettinger and Cayan 1995). Projected warming is expected to affect Central Valley Chinook salmon. Because the runs are restricted to low elevations as a result of impassable rim dams, if climate warms by 5°C (9°F), it is questionable whether any Central Valley Chinook salmon populations can persist (Williams 2006).

For SR winter-run Chinook salmon, the embryonic and larval life stages that are most vulnerable to warmer water temperatures occur during the summer, so this run is particularly at risk from climate warming. 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 input from springs) will be more susceptible to impacts of climate change. 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). The Anderson Cottonwood Irrigation Dam (ACID) is considered the upriver extent of green sturgeon passage in the Sacramento River. The upriver extent of green sturgeon spawning, however, is approximately 30 kilometers downriver of ACID where water temperature is higher than ACID during late spring and summer. Thus, if water temperatures increase with climate change, temperatures adjacent to ACID may remain within tolerable levels for the embryonic and larval life stages of green sturgeon, but temperatures at spawning locations lower in the river may be more affected.

Stream flow is a highly important variable and driving mechanism in fluvial ecosystems and climate has been identified as a landscape-scale driver of flow rates (Minshall 1988). Multiple climatological and hydrologic model predictions indicate that flows in the CCV will decrease throughout the 21st century as warming trends continue. Salmonids in the Sacramento River are facing a decrease in flows, resulting in potentially lethal or sub-lethal water temperatures in summer months, impaired migration and decreased egg to fry recruitment. In addition to altered flow regimes, some other aspects of stream systems that are particularly sensitive to changes in climate are sediment transport/channel alterations, nutrient loading and rates of nutrient cycling, fragmentation and isolation of cold-water habitats, altered exchanges with the riparian zone and life history characteristics of many aquatic insects (Meyer *et al.* 1999). Current warming trends and model predictions indicate that it is likely that climate change will result in some direct and indirect adverse effects to salmonids in the Sacramento River in the 21st century.

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). Miner Slough Bridge is located at position 38.291847, -121.630818 in the Northern region of the Sacramento/San Joaquin River Delta, connecting Ryer Island with the mainland. The Project is located approximately 13 miles north of Rio Vista in Solano County, California. The bridge is located at post mile (PM) 12.1/12.2 on SR 84. The bridge traverses the active flow channel of Miner Slough and connects Ryer Island in the Sacramento-San Joaquin River Delta (Delta) to the mainland. Most of the Project area is located adjacent to the active channel of Miner Slough, a tributary of the Sacramento River. The Project is located within the Liberty Island U.S. Geological Survey (USGS) 7.5-minute topographic quadrangle. Miner Slough flows south into the Sacramento River and Suisun Bay, which flows into the San Francisco Bay. Miner Slough is a navigable waterway that ebbs and flows with the tide, with a depth of about 6 ft to the Median High Water Mark. The action area encompasses 14.24 ac of Miner Slough (approximately 2,132 ft upstream and 984 ft downstream of the bridge), as well as 1.74 ac of riparian area, emergent seasonal wetland area, and shrub scrub wetland area. The action area includes areas adjacent to the Project that may be adversely affected by (but not limited to) the following: noise generated by pile driving; sedimentation and increased turbidity; and construction-related effects.

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 Project is located in the northern portion of the Sacramento-San Joaquin Delta, an area commonly referred to as the north Delta. The Delta region historically supported a healthy aquatic ecosystem, but its habitat value for ESA-listed species is considered greatly reduced from historic conditions. Since the 1850s, wetland reclamation for urban and agricultural development has caused the cumulative loss of 96 percent of seasonal wetlands and 94-98 percent of riparian forests in the Central Valley (Whipple *et al*. 2012). Several factors are thought to contribute to the decline in the health of the habitat including: entrainment into the south Delta State Water Project (SWP) and Central Valley Project (CVP) pumping facilities, reverse flows, maintenance dredging in the ship channels, and increased predation by non-native predator species (*e.g.*, striped bass and largemouth bass) (Baxter *et al.* 2007). The increase in the abundance of largemouth bass, as shown by the salvage data at the CVP and SWP pumps, occurred at the same time as the increase in the range of the invasive submerged macrophyte Egeria densa (Brown and Michniuk 2007).

In the central Delta region, low-salinity water management, invasive aquatic plants (*Egeria densa*), and other factors have resulted in increased numbers of nonnative predators, most important of which are striped bass and largemouth bass. Nobriga and Feyrer (2007) report that largemouth bass have a more limited distribution in the Delta than striped bass, although their impact on prey species, such as juvenile salmonids, is higher. The proliferation of *E. densa* provides habitat for largemouth bass as well as their prey, and its rapid expansion in the Delta increased more than 10 percent per year from 2004 to 2006 (Baxter *et al.* 2007). Although Chinook salmon fry are often found in the central Delta and make use of the dense stands of *E. densa* for habitat, Brown (2003) found that survival is lower for fry rearing in the central Delta than those rearing in tributary streams. Those fry that migrate through the central Delta rather than directly through the Sacramento or San Joaquin River also have a lower survival rate (Brown 2003).

Aside from increasing the habitat area for predators, the proliferation of *E. densa* and water hyacinth (*Eichhornia crassipes*) may have other negative impacts on ESA-listed species. It can overwhelm littoral habitats where salmonids and sDPS green sturgeon rear, and it also appears to contribute to the recent reduction in turbidity of the central and south Delta regions by reducing flow velocity (Brown 2003) and mechanically filtering the water column (Nobriga *et al.* 2005). The resulting increased water clarity has negative effects on juvenile salmonids by increasing their susceptibility to predation. The U.S. Department of Agriculture and California Division of Boating and Waterways have an active program to control aquatic invasive plant species in the Delta using a variety of treatment methods.

2.4.1. Status of Listed Species in the Action Area

The action area functions primarily as a migratory corridor for SR winter-run, CV spring-run, CCV steelhead, and sDPS green sturgeon. In addition, it also provides some use as holding and rearing habitat for each of these species. Juvenile salmonids may use the area for rearing for several months during the winter and spring. Green sturgeon use the area for rearing and migration year round. Adult winter-run typically migrate through the estuary/Delta between November and June with the peak occurring in March. Adult CV spring-run migrate through the Delta from January to June. Adult CCV steelhead migration typically begins in August and extends through the winter to as late as May, and adult green sturgeon start to migrate upstream in February and can extend into July. Generally, juveniles migrate downstream in the winter and spring.

SR winter-run Chinook salmon

SR winter-run use the north Delta primarily as a migration corridor. Relative abundance is inferred through salvage monitoring data, CDFW rotary screw trap sampling, and U.S. Fish and Wildlife Service (USFWS) Delta Juvenile Fish Monitoring Program (DJFMP) data. Juvenile winter-run occur in the Delta primarily from November through early May, using length-at-date criteria from trawl data in the Sacramento River at West Sacramento (USFWS 2012). Adult escapement and spawning migration through the Delta is expected to begin in January and extend through the end of April.

CV spring-run Chinook salmon

CV spring-run Chinook salmon are thought to use the north Delta region as a migration corridor and there is evidence that they utilize this area for juvenile rearing as well. Allen and Hassler (1986) showed that in estuaries, as juvenile Chinook salmon increase in length, they tend to school in the surface waters of the main and secondary channels and sloughs, following the tides into shallow water habitats to feed. Within the Delta, juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels, and sloughs (McDonald 1960, Dunford 1975). A unique trait of CV spring-run Chinook salmon life history relative to other Central Valley salmonids is the tendency for some juveniles to exhibit rearing in their natal stream for up to a year prior to outmigration. These "yearlings" may enter the Delta as early as November or December and continue outmigration through March. In addition to Delta rearing of fry and parr life stages, yearling individuals may utilize the north Delta for rearing as well. Peak outmigration of juvenile CV spring-run Chinook salmon occurs in March and April and drops off in May. Adult escapement typically occurs from April through June and may extend into early summer.

CCV steelhead

CCV steelhead are known to utilize the north Delta region primarily as a migration corridor for spawning adults migrating to spawning reaches upstream and for out-migrating juveniles, providing access to the ocean. Adult steelhead enter freshwater in August (Moyle 2002) and peak migration of adults move upriver in late September (Hallock *et al.* 1957), which falls within the in-water work window. Adult steelhead will hold until flows are high enough in the tributaries to migrate upstream where they will spawn from December to April (Hallock *et al*. 1961). Two ongoing monitoring studies that are typically used as indicators of presence and abundance of CCV steelhead in the Delta are the USFWS delta juvenile fish monitoring program (DJFMP), which includes a Kodiak trawl survey at Chipps Island; and the CDFW and Reclamation salvage monitoring efforts at the SWP/CVP export facilities. Juvenile steelhead sampled at Chipps Island show a difference in outmigration timing between natural and hatchery origin CCV steelhead (Nobriga and Cadrett 2001, USBR 2008). Hatchery origin fish were shown to outmigrate from the Sacramento River watershed to the ocean between January and March. Natural-origin fish displayed a more varied migration pattern with outmigration timing spread over a greater temporal scale, extending into spring and summer, suggesting that some juveniles may be present in the action area during the scheduled in-water work window. Since the mid-1990s, salvage data has shown an overall decrease in the percent of natural origin vs. hatchery origin CCV steelhead recovered, as well as a decrease in relative abundance. These findings are indicative of a decrease in natural origin steelhead occupying the Delta.

sDPS green sturgeon

The north Delta functions as both rearing habitat and as a migration corridor for sDPS green sturgeon. Based on salvage monitoring data, sDPS green sturgeon may be present in the Delta year-round, with data suggesting that presence there peaks in July and August. Little is known about downstream migration timing of juveniles, however they are thought to rear in the Delta prior to entering the ocean, marking the transition from juvenile to subadult life stages. Ocean entry timing is also poorly understood. Nakamoto *et al.* (1995) found that on average, green sturgeon on the Klamath River migrated to sea by age three and no later than age four. Laboratory experiments indicate that green sturgeon juveniles may occupy fresh to brackish water at any age, but they gain the physiological ability to transition to saltwater at approximately 1.5 years of age (Allen and Cech 2007). This information suggests that some juvenile and subadult green sturgeon will likely occupy the action area during the scheduled in-water work window. Based on data from acoustic tags (Heublein *et al.* 2009), adult sDPS green sturgeon leave the ocean and enter San Francisco Bay between January and early May. Migration through the bay/Delta takes about one week and progress upstream is fairly rapid to their spawning sites (Heublein *et al*. 2009).

2.4.2. Status of Critical Habitat in the Action Area

CCV steelhead and CV spring-run Chinook salmon

The Action Area includes critical habitat that has been designated for CCV steelhead and CV spring-run Chinook salmon. Critical habitat was designated under the same federal ruling for these two species as their habitat requirements are very similar. The PBFs for these species' designated critical habitat that occur in the action area are: Migration Corridor and Estuarine Areas. Due to adjacent agricultural activity, levee construction and maintenance, shoreline armoring, removal of riparian and wetland vegetation, and removal of woody debris, these PBFs have been significantly degraded from their natural historical condition. Similar activities throughout the north Delta have resulted in degradation of these PBFs across the entire region. Conditions for juvenile rearing in these areas are poor and likely contribute to reduced growth and survival of these species.

SR winter-run Chinook salmon

Critical habitat PBFs for SR winter-run Chinook salmon that occur in the action area are: Access from the Pacific Ocean to appropriate spawning areas in the upper Sacramento River, Habitat and adequate prey free of contaminants, Riparian habitat that provides for successful juvenile development and survival, and access of juveniles downstream from the spawning grounds to San Francisco Bay and the Pacific Ocean. These PBFs have been significantly degraded from their historical condition and this degradation has contributed to the decline of this species. Access to historical spawning habitat upstream of Keswick and Shasta dams has been completely blocked. As in the case of CV spring-run Chinook salmon and CCV steelhead, the quality and quantity of riparian habitat in the north Delta region has been degraded from its historical condition, reducing its overall functionality. Due to increasing urbanization, nearshore development, agriculture, and other human activities, the aquatic ecosystem in the Delta is exposed to a wide variety of contaminants. Multiple studies have documented high levels of contaminants in the Delta (Leatherbarrow *et al.* 2005, Brooks *et al*. 2012), suggesting that fish are exposed to them; however, the inability to characterize concentrations and loading dynamics makes it difficult to quantify transport and total contaminant loading in the system (Johnson *et al.* 2010). Highly managed hydrologic conditions in the Sacramento River likely impact outmigration patterns of juveniles, as outmigration timing has been correlated with high flow events.

sDPS green sturgeon

The following PBFs for sDPS green sturgeon occur in the Action Area: Food Resources; Water Flow; Water Quality; Migratory Corridor; Water Depth; and Sediment Quality. Weston *et al*. (2004) found that measured levels of toxic substances throughout the Central Valley sourced from agricultural activity result in lethal effects to aquatic macroinvertebrates (*Hyalella Azteca*, an amphipod) and *Chironomus tentans* (midge). These findings suggest that the benthic food resources of sDPS green sturgeon may be impacted by agricultural activity in the north Delta. Throughout the north Delta, water flow and quality has been degraded from historical conditions and is particularly poor during drought years. Low-flow conditions increase water temperatures and can potentially create thermal barriers. Input of inorganic nutrients and contaminants from agricultural runoff has created poor water quality conditions in the north Delta and has had a negative impact on the aquatic ecosystem. Although levee construction and shoreline armoring has had less of an impact on juvenile rearing habitat of sDPS green sturgeon relative to listed salmonids, the change in habitat structure and substrate types has likely impacted food resources, piscivorous predator abundance and flow dynamics in the north Delta.

2.4.3. Factors Affecting Listed Species and Critical Habitat in the Action Area

Range-wide factors that affect listed fish species are described in section 2.2. This section will focus on factors that are specific to the Action Area.

The north Delta region has been degraded from its historic condition and many anthropomorphic and naturally occurring factors have led to the decline of anadromous fish in the system. Due to the construction of dams on the majority of major tributaries to the Sacramento River, flows and temperatures have been altered from their natural and historic regimes. Altered flow regimes can influence migratory cues, water quality (including contaminants, dissolved oxygen and nutrients for primary productivity) and temperature. Construction of the dams has also restricted access to historic spawning and rearing habitat, leading to the decline of anadromous fish abundance in the Sacramento River Basin. This is particularly true for SR winter-run Chinook salmon. Many of the PBFs described in section 2.4.2 have been impacted by altered and reduced flows in the north Delta. Drought conditions have played a significant role in the past 5 years as flows have decreased and summer temperatures have increased, leading to unfavorable environmental conditions in the Sacramento River watershed. This has resulted in direct and indirect impacts to listed fish as well as impacts to critical habitat. Increased temperatures also have the potential to disrupt aquatic macroinvertebrate production, leading to declines in food availability (Ward and Stanford 1982).

The north Delta has been heavily urbanized. This has likely increased the magnitude of contaminant loading in the aquatic ecosystem. Heavy metals, polycyclic aromatic hydrocarbons (PAHs), petroleum products, plastics, fertilizer and many other contaminants can enter the river via urban runoff. Shore side development leads to decreased recruitment of large woody material and results in a loss of habitat complexity, which is a critical component of the freshwater rearing PBF.

2.4.4. Importance of the Action Area to the Survival and Recovery of Listed Species

The north Delta contains viable rearing and migratory habitat for listed anadromous fish species. In a fully functional state, it promotes growth, survival and proliferation of the species. The specific frequency and magnitude of habitat utilization within Miner Slough by each species is not well understood and may vary among water year types. Presumably, it serves as a migration corridor for all listed species addressed in this BO, providing access to spawning grounds for returning adults, as well as access to estuarine and ocean habitats for outmigrating juveniles. Miner Slough provides rearing habitat that is likely utilized by juvenile and subadult sDPS green sturgeon, although the spatial dynamics of rearing at those life stages is not well understood. Miner Slough contains designated critical habitat for all listed species addressed in this BO and the action area contains PBFs related to rearing and migration (see section 2.4.2). These PBFs are of critical importance in the north Delta region, as it serves as a spatial link between all habitats located within each species' geographical range (spawning/freshwater and estuarine/ocean). The NMFS Recovery Plan for Central Valley Chinook Salmon and Steelhead (NMFS 2014a) identifies recovery actions in the Delta that are of vital importance to the eventual recovery of these listed species. The following recovery actions pertain to the proposed action and the habitat located within the action area:

- Restore, improve, and maintain salmonid rearing and migratory habitats in the Delta and Yolo Bypass to improve juvenile salmonid survival and promote population diversity.
- Utilize biotechnical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap.
- Increase monitoring and enforcement to stop illegal rip rap applications in the Delta.
- Curtail further development in active Delta floodplains through zoning restrictions, county master plans and other Federal, State, and county planning and regulatory processes, and land protection agreements.
- Implement management actions for addressing invasive aquatic species, including those described in the California Aquatic Invasive Species Management Plan.
- Continue development of a long-term strategy for monitoring and regulating discharges from agricultural lands to protect waters within the Central Valley, including enforcing the regulations.

The NMFS Recovery Plan for sDPS green sturgeon (NMFS 2018) identifies the following recovery actions pertaining to the proposed action and the habitat located within the action area:

- Improve compliance with and implementation of Best Management Practices (BMPs) to reduce input of point and non-point source contaminants within the Sacramento River Basin (SRB) and San Francisco Bay Delta Estuary (SFBDE).
- Evaluate the effects of habitat modification and/or restoration on green sturgeon recruitment and growth.
- Conduct research to identify contaminants and contaminant concentrations in all life stages of green sturgeon and their prey base.
- Conduct research to determine the toxicity of identified contaminants on green sturgeon and their prey base.

- Monitor trends in the annual production and habitat use of juvenile sDPS green sturgeon in the SRB and SFBDE.

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).

The proposed action includes activities that may impact CCV steelhead, CV spring-run Chinook salmon, SR winter-run Chinook salmon, sDPS green sturgeon and/or their respective critical habitats. The following is an analysis of the potential effects to listed fish species and/or their critical habitat that may occur as a result of implementing the Miner Slough Bridge Replacement Project.

2.5.1. Effects to Species

The following is an analysis of the potential effects to listed fish species in the north Delta that may occur as a result of implementing the proposed action. For our analysis, we have used the presence of listed species in the action area to determine the risk each species and life stage may face if exposed to Project impacts. The expected effects of the proposed action include impacts due to: (1) hydroacoustic impacts, (2) dewatering and fish relocation, (3) sedimentation and turbidity, and (4) contaminant and pollutant-related effects.

Hydroacoustic Impacts
Construction of the new in-water bridge structure will require the use of both vibratory and impact pile driving to install the steel piles for the temporary trestle and dolphins, sheetpiles for the temporary cofferdam, CISS piles for permanent bridge piers, and removal of temporary piles. During the construction period, piles will be temporarily placed into Miner Slough by combination of vibratory hammer and impact hammer during the proposed in-water work window of August 1 to November 30 for up to 3 seasons.

Pile driving near or in water has the potential to kill, injure, and cause delayed death to fish through infection of minute internal injuries, or cause sensory impairments leading to increased susceptibility to predation. The pressure waves generated from driving piles into river bed substrate propagate through the water and can damage a fish's swim bladder and other internal organs by causing sudden rapid oscillations in pressure, which translates to rupturing or hemorrhaging tissue in the bladder when the air in swim bladders expand and contract (Gisiner 1998, Popper *et al*. 2006). Sensory cells and other internal organ tissue may also be damaged by pressure waves generated during pile driving activities as sound reverberates through a fish's viscera (Caltrans 2015). In addition, morphological changes to the form and structure of auditory organs (saccular and lagenar maculae) have been observed after intense noise exposure (Hastings and Popper 2005). Smaller fish with lower mass are more susceptible to the impacts of elevated sound fields than larger fish, so acute injuries resulting from acoustic impacts are expected to scale based on the mass of a given fish. Since juveniles and fry have less inertial resistance to a passing sound wave, they are more at risk for non-auditory tissue damage (Popper and Hastings 2009) than larger fish (yearlings and adults) of the same species. Beyond immediate injury, multiple studies have also shown responses in the form of behavioral changes in fish due to human-produced noises (Wardle *et al.* 2001, Slotte *et al.* 2004, Popper and Hastings 2009).

Based on recommendations from the Fisheries Hydroacoustic Working Group, NMFS uses interim dual metric criteria to assess onset of injury for fish exposed to pile-driving sounds (Caltrans 2015). The interim thresholds of underwater sound levels denote the expected instantaneous injury/mortality and cumulative injury, as well as a third threshold criterion for behavioral changes to fish. Vibratory pile driving generally stays below injurious thresholds, but often introduces pressure waves that will incite behavioral changes. Even at great distances from the pile-driving location, underwater pressure changes/noises from pile driving is likely to cause flight, hiding, feeding interruption, area avoidance, and movement blockage, as long as pile driving is ongoing.

For a single strike, the peak exposure level (peak) above which injury is expected to occur is 206 decibels (dB) underwater (reference to one micro-pascal [1µpa] squared per second). However, cumulative acoustic effects are expected for any situation in which multiple strikes are being made to an object with a single strike peak dB level above the effective quiet threshold of 150 dB. Therefore, the accumulated sound exposure level (SEL) level above which injury to fish is expected to occur is 187 dB for fish greater than 2 grams in weight, and 183 dB for fish less than 2 grams. If either the peak SEL or the accumulated SEL threshold is exceeded, then physical injury is expected to occur to fish within the estimated distance thresholds. Underwater sound levels below injurious thresholds are expected to produce behavioral changes. NMFS uses a 150 dB root-mean-square (RMS) threshold for behavioral responses in salmonids and green sturgeon.

Noise levels for impact pile driving are as follows (and summarized in Table 4):

The peak level for impact driving 14-inch steel pipe piles in-water are estimated to be 200 dB at 10 meters (m) and the distance to the 206 dB peak criteria is estimated to be 4 m from the pile. The distance to the 187 dB cumulative SEL criteria would be approximately 74 m from the pile and the distance to the 183 dB cumulative SEL criteria would be approximately 136 m from the pile.

The peak level for impact driving 36-inch steel temporary trestle piles in-water are estimated to be 210 dB at 10 m and the distance to the 206 dB peak criteria is estimated to be 18 m from the pile. The distance to the 187 and 183 dB cumulative SEL criteria would be approximately 1000 m from the pile.

The peak level for impact driving of the 60-inch CISS piles in-water may reach 210 dB at 10 m. The distance to the 206 dB peak criteria would be 18 m from the pile. The distance to the 187 dB cumulative SEL criteria would be approximately 1168 m from the pile and the distance to the 183 dB cumulative SEL criteria would be approximately 2154 m from the pile.

Table 4. Summary of Estimated Underwater Sound Exposure Levels.

Pile Type	Driver Type	Number of Strikes Per Pile	Strikes Per Day	Reference Distance (m)	Attenuation (dB)	Peak (dB)	SEL (dB)	RMS (dB)	Distance (m) to Threshold			
									Onset of Physical Injury			Behavior
									Peak dB	Cumulative SEL dB		RMS dB
										Fish >2 g	Fish < 2 g	
									206 dB	187 dB	183 dB	150 dB
14" steel pipe pile in water	impact hammer	1,000	1,000	10	0	200	170	180	4	74	136	1000
36" steel pipe pile in water (92)	impact hammer	1,800	9,000	10	0	210	180	190	18	1000	1000	4642
60" CISS pile in water (6)	impact hammer	2,000	2,000	10	0	195	170	180	18	1168	2154	10000

The distance that behavioral changes are expected is up to 650 m from the driven pile, where the RMS sound will be above 150 dB RMS. SELs below 150 dB are assumed not to accumulate and cause fish injury, or be significantly different from ambient conditions (*i.e*., effective quiet). Pressure levels in excess of 150 dB RMS are expected to cause temporary behavioral changes (startle and stress) that could decrease a fish's ability to avoid predators or delay normal migration past the work site. The background RMS sound pressure levels, or effective quiet, are assumed to be 150 dB RMS and the acoustic impact area is the area where the predicted RMS sound pressure level generated by pile driving exceeds this threshold.

Once the pressure waves attenuate below this level, fish are assumed to no longer be adversely affected by pile-driving sounds. Under the concept of effective quiet being less than or equal to 150 dBRMS, the distance fish are expected to be adversely affected during pile driving is out to 10,000 m from the location of the pile being driven, assuming a transmission loss constant of 15 (NMFS 2008). However, the Caltrans 2015 Pile Driving Compendium states, "it is not possible to reliably predict audibility (or detectability) with any certainty at distances beyond 500 to 1,000 meters. Consequently, the Project action area based on pile driving sound should never be considered to extend more than 1,000 meters (3,280 ft. or 0.62-mile) from the pile driving activity." Additionally, the maximum anticipated distances to the various thresholds described above are constrained by bends in the river channel, 300 m to the west of the bridge and 650 m to the east. Substantial noise from pile-driving activity is not anticipated to propagate past these bends. Based on this guidance, noise effects are only considered within 650 m of the pile-driving activity.

The underwater sound conditions described above would be expected to occur on days when in-water pile driving of 14-inch and 36-inch steel pipe piles or 60-inch CISS piles occur. Pile driving would occur only during daylight hours to minimize effects. Impact pile driving is expected to directly injure or kill fishes within certain distance thresholds, depending on the size of pile being driven, the number of strikes used in a day, and whether attenuation measures are being employed. Using the greatest numbers of strikes estimated to drive the largest piles, it is expected that fish may be killed within up to 20 m of the driven pile and injured or disturbed within 650 m due to in-water impact pile driving. Small numbers of juvenile and adult CCV steelhead and sDPS green sturgeon are expected to be affected.

Dewatering and Fish Relocation
Following installation of the cofferdams around the existing center pier, dewatering will take place to make way for demolition. During the dewatering and fish rescue process, take may occur in the form of harassment as fish are handled and removed from the dewatered area. Seine nets, dip nets and/or electrofishing methods may be used to remove fish. Some incidental injury or mortality may occur during this process, because fish experience abrasion from handling, exposure to air, and close proximity to one another as they are placed in the temporary holding tank. In addition, electrofishing techniques may result in some incidental injury or mortality. Throughout the duration of the Project, based on best available information regarding relative abundance and migration timing, NMFS estimates that no more than 2 juvenile or subadult sDPS green sturgeon, 1 adult green sturgeon, 3 juvenile CCV steelhead, and/or 1 adult CCV steelhead may become entrained within the cofferdam or 60-inch piles.

Sedimentation and Turbidity
Increased sedimentation and turbidity may occur as a result from the following construction activities within the channel: pile-driving activities associated with the construction of the new bridge and temporary trestles, demolition of the existing bridge, and dewatering activities. Sources of sedimentation and increased turbidity outside of the channel include: realignment activities, excavation and installation of new bridge abutments, and post-project recontouring and regrading activities.

Juvenile and adult CCV steelhead are known to utilize the action area as a migration corridor during the proposed in-water work window and are, therefore, expected to be present during construction activities. Increased sedimentation and turbidity could potentially have adverse effects to adult CCV steelhead though gill fouling, reduced foraging ability and reduced predator avoidance (Kemp *et al*. 2011). Juvenile salmonids are not likely to avoid increased levels of turbidity below a level of 70 nephelometric turbidity units (NTU) (Bash *et al.* 2001). As a result, they may at greater risk to turbidity and sediment-related effects than adults. One effect of turbidity that has important implications for juvenile salmonids is that predator avoidance behavior has been shown to decrease at increased levels of turbidity (Gregory 1992). Growth and survival amidst increased sediment and turbidity levels has also been shown to decrease resulting from reduced prey detection and availability and physical injury due to increased activity, aggression and gill fouling (Suttle *et al.* 2004, Kemp *et al* 2011).

Less information is available on the abundance and distribution at various life stages of sDPS green sturgeon. However, based on the best available information on their life history, individuals at the juvenile, sub-adult and adult life stages are expected to be present in the action area. Large increases in turbidity as well as sedimentation events have the potential to cause acute injury by gill fouling in sDPS green sturgeon. BMPs) and other minimization and avoidance measures will be implemented during construction to avoid or minimize increases in turbidity and sediment- related effects (see Section 1.4). Also, due to the relatively small spatial scale of the action area and proposed activities, increases in turbidity are expected to be transient in nature. Potential adverse effects to juvenile and adult CCV steelhead, and juvenile, sub-adult, and adult sDPS green sturgeon resulting from sedimentation and increases in turbidity will be minimal.

Contaminants and Pollutant Related Effects
The proposed action will involve heavy construction equipment and many potential sources of hazardous material contamination in the Action Area. Potential sources of pollutants include hazardous material spills, petroleum product leaks in construction equipment, introduction of metals from the operation of equipment and vehicles and the disturbance of sediments that may contain hazardous suspended particulates. BMPs and avoidance and minimization techniques will be implemented, minimizing the probability of pollutant incursion into Miner Slough. However, unlike sedimentation and turbidity-related effects, potential pollution-related effects have the potential to be highly persistent in the Action Area and may affect multiple species and life stages, if they were to occur.

Incursion of contaminants into the action area has the potential to effect species present at the time of construction or possibly afterwards. Construction equipment and heavy machinery will be present in the action area and metals may be deposited through their use and operation (Paul and Meyer 2001). These materials have been shown to alter juvenile salmonid behavior through disruptions to various physiological mechanisms, including sensory disruption, endocrine disruption, neurological dysfunction and metabolic disruption (Scott and Sloman 2004). Oil-based products used in combustion engines are known to contain PAHs, which have been known to bio-accumulate in other fish taxa such as Pleuronectiformes and have carcinogenic, mutagenic and cytotoxic effects (Johnson *et al* 2002). The exact toxicological effects of PAHs in salmonids and sturgeon is not well understood, although studies have shown that increased exposure of salmonids to PAHs reduced immunosuppression, increasing their susceptibility to pathogens (Arkoosh *et al.* 1998, Arkoosh and Collier 2002). Adult CCV steelhead and juvenile, sub-adult and adult sDPS green sturgeon are expected to be present in the action area during construction activities and would potentially be acutely injured by a pollution event. Other listed species and life stages are expected to be present in Miner Slough during winter and spring months and could be indirectly affected by a pollution event, if contaminants were to settle within substrate in the active channel that may become disturbed at a later time.

BMPs, avoidance and minimization measures are described in Section 1.4 and will minimize potential adverse effects to listed fish species resulting from the incursion of contaminants into Miner Slough.

2.5.2. Effects to Critical Habitat

Critical habitat has been designated in the Action Area for CCV steelhead, CV spring-run Chinook salmon, SR winter-run Chinook salmon, and sDPS green sturgeon. The following analysis includes potential effects to critical habitat PBFs resulting from the proposed action.

Sedimentation
The action area contains rearing and migration habitat for all species addressed in this BO, with the potential for degradation of PBFs resulting from sedimentation associated with the proposed action. Kemp *et al*. (2011) describe a suite of physiochemical effects to lotic aquatic systems resulting from increased sedimentation and sediment-related events. Most notably, sedimentation

events in a system that shares both lotic and estuarine characteristics have the potential to increase turbidity on a broad temporal scale and reduce oxygen supply. These impacts would degrade the PBFs of Migratory Corridor and Estuarine Areas for CCV steelhead and CV spring-run Chinook salmon; and riparian habitat that provides for successful juvenile development and survival for SR winter-run Chinook salmon. Additionally, sedimentation has the potential to reduce benthic invertebrate density and result in the loss of physical habitat. Therefore, the following PBFs for sDPS green sturgeon could potentially be impacted by sedimentation: Food Resources, Water Quality, Migratory Corridor, Water Depth, and Sediment Quality.

BMPs, minimization and avoidance measures will be implemented during construction to avoid or minimize sediment-related effects (see Section 1.4). Potential adverse effects to critical habitat PBFs for the species addressed in this BO resulting from sedimentation will be minimal as they will not occur at a scale in which habitat will be permanently impacted or reduce the conservation value of critical habitat.

Riparian Vegetation Removal
Removal of riparian vegetation will occur in the process of operating heavy construction machinery, equipment staging, and installation of the new infrastructure associated with the Project. These activities have the potential to have adverse effects on critical habitat PBFs. Riparian vegetation plays a key role in the conservation value of rearing habitat for many salmonid and green sturgeon life stages. It provides shading to lower stream temperatures; increases the recruitment of LWM into the river, increasing habitat complexity; provides shelter from predators; and enhances the productivity of aquatic macro invertebrates (Pusey and Arthington 2003, Anderson and Sedell 1979). It has also been shown to directly influence channel morphology and may be directly correlated with improved water quality in aquatic systems (Dosskey *et al*. 2010, Schlosser and Karr 1981). It has been suggested by Dosskey *et al*. (2010) that presence and abundance of riparian vegetation can be directly correlated with water quality in riverine systems through biogeochemical cycling, soil and channel chemistry, water movement and erosion.

A total of 0.09 ac of forested riparian habitat will be permanently lost and 0.162 ac will be temporarily lost as a result of this Project. This loss of riparian vegetation will result in the degradation of Migratory Corridors and Estuarine Area critical habitat PBFs for CCV steelhead and CV spring- run Chinook salmon; Riparian habitat that provides for successful juvenile development and survival PBF for SR winter-run Chinook salmon; and Food Resources, Water Quality, and Migratory Corridor PBFs for sDPS green sturgeon. However, losses of riparian vegetation due to the implementation of the proposed action will be minimized and effects will be mitigated through the use of BMPs, minimization and avoidance measures, and on-site restoration activities described in Section 1.4. The loss of riparian vegetation will occur at a small, localized spatial scale and will not reduce the conservation value of critical habitat.

2.6. Cumulative Effects

"Cumulative effects" are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation [50 CFR 402.02 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).

The north Delta region has experienced heavy agricultural activity and urbanization in the last century, leading to habitat loss, degradation of existing habitat and degradation of water quality. Grazing activities of livestock adjacent to water ways as well as the application of pesticides, herbicides and fertilizer result in an influx of harmful chemicals and inorganic nutrients that reduce the conservation value of existing fish habitat. In addition, agricultural and urban infrastructure have increased, altering the natural geomorphology of the north Delta and leading to increased inputs of contaminants. Urbanization increases the demand for additional infrastructure and access to natural resources such as potable water, natural gas, electricity, etc. Recreational uses of the north Delta region have increased, as well as local urban populations have grown in the area. Boat use and other associated activities have led to increased shoreline development, leading to losses of riparian and wetland habitat. Boating activities may also directly impact riparian and wetland habitat as boats may operate in shallow, near shore areas. Contaminants that may have settled in sediments may be churned up by boat propellers and suspended in the water column. Additionally, recreational boats serve as primary vectors for the spread of invasive aquatic organisms including both invertebrates and plant species.

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 Environmental Baseline

The Status of the Species, Critical Habitat, and Environmental Baseline sections show that past and present impacts to the Sacramento and San Joaquin river basins and the Delta have caused significant habitat loss, fragmentation, and degradation throughout the historical and occupied areas for these species. These impacts have created the conditions that have led to substantial declines in the abundance and long term viability of their populations in the Central Valley. As a result, NMFS has determined in its most recent 5-year reviews (NMFS 2015, 2016a; and Williams 2016) that the listings are still warranted, and that the current status of these fish has continued to decline since the previous reviews in 2011.

Alterations in the geometry of the Delta channels (straightening), removal of riparian vegetation and shallow water habitat, construction of armored levees for flood protection, changes in river flow created by diversions (including pre-1914 riparian water right holders, CVP and SWP contractors, and municipal entities), and the influx of contaminants from agricultural and urban dischargers have substantially reduced the functionality of the aquatic habitat within the action area.

The multi-year drought conditions in California from 2012 through 2016 have negatively affected winter-run, CV spring-run, and CCV steelhead, exacerbating the conditions that led to the species being listed. Lethal water temperatures below the rim dams have reduced the viability of eggs in the gravel for winter-run and CV spring-run, and have made tributaries excessively warm over the summer and fall seasons due to a lack of snow and snow melt runoff. Early life stages of sDPS green sturgeon are expected to be less affected by the increased temperatures in the waters in which they spawn due to their higher thermal tolerances in the early life stages compared to salmonids.

2.7.2. Summary of Effects of the Proposed Action

The proposed action will occur over 3 seasons from August 1 to November 30. The majority of effects of the bridge construction will be temporary in nature. Based on Project timing, the proposed action will result in negative effects to adult CCV steelhead; and juvenile, sub-adult, and adult sDPS green sturgeon. Hydroacoustic effects will result in take of these species as impact-hammer pile-driving techniques will be implemented and sound levels are projected to exceed the "effective quiet" threshold of 150 dB established by the FHWG. Acoustic impacts may result in acute injury and/or behavioral effects. Dewatering activities will cause take in the form of harassment as fish are handled and stored temporarily prior to their release back into Miner Slough. Sedimentation and increases in turbidity may occur as a result of pile-driving activities associated with the construction of the new bridge, temporary trestle, and operator control house; demolition of the existing bridge; geotechnical drilling; and dewatering activities. Additionally, the potential exists for contaminant incursion into the channel, which could result in acute toxicity to listed fish species occupying the action area at the time of construction, or may result in contamination of sediment that could be re-suspended at a later time. Following the analysis of the BA and supporting materials, NMFS finds that the proposed minimization and avoidance measures will be sufficient to limit the effects of sedimentation, turbidity, and contaminants to levels which are not expected to result in take.

Critical habitat has been designated in the action area for all four species addressed in this BO. The Project will result in minor losses of benthic habitat due to the suspension of sediment associated with pile driving, installation of the coffer dam around pier 3 the removal of the existing bridge. Additionally, minor losses of riparian habitat will occur as a result of the added infrastructure associated with the Project. PBFs pertaining to rearing and migration for all species will be impacted to a minor extent, however, there is ample analogous habitat upstream and downstream of the action area. It is NMFS' determination that impacts will not result in channel-wide effects or reduce the conservation value of critical habitat and, therefore, will not impair the fitness, survival and recovery of these listed species.

2.7.3. Survival and Recovery

Miner Slough serves as a migratory corridor for all species addressed, providing access between estuarine/ocean habitat and freshwater rearing and spawning habitat. It also provides rearing habitat which is thought to be utilized by sDPS green sturgeon, although the spatial dynamics of their rearing behavior in the north Delta is not well understood. The habitat present in the action area falls under many of the PBF characterizations for each listed species. Although conservation value of the habitat present in the action area has been degraded from its historical condition, it remains functional to some degree and contributes to the carrying capacity of the north Delta region to support anadromous fish species. Recovery actions identified in Section 2.4.4 highlight the importance of the north Delta region to the survival and recovery of the species addressed in this document.

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 CCV steelhead, CV spring-run Chinook salmon, SR winter-run Chinook salmon, 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.

2.9.1. Amount or Extent of Take

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

NMFS anticipates incidental take of CCV steelhead and sDPS green sturgeon from impacts directly on designated critical habitat PBFs, or related to pile driving and impairment of essential behavior patterns as a result of these activities, and potential fish dewatering and handling. The incidental take is expected to be in the form of harm, harassment, injury or mortality of CCV steelhead, and sDPS green sturgeon resulting from the installation and removal of temporary and permanent piles during bridge construction. Incidental take is expected to occur for during the in-water work window (August 1 to November 30) when CCV steelhead and sDPS green sturgeon individuals are rearing or migrating past the site.

It is not practical to quantify or track the amount or number of individuals that are expected to be incidentally taken as a result of the proposed action, due to the variability associated with the response of listed fish to the effects of the proposed action, annual variations in the timing of spawning and migration, individual habitat use within the action area, and difficulty in observing injured or dead fish.

However, it is possible to estimate the extent of incidental take by designating ecological surrogates, and it is practical to quantify and monitor the surrogates to determine the extent of incidental take that is occurring. The most appropriate threshold for incidental take are ecological surrogates of temporary habitat disturbance expected to occur during in-water construction, pile-driving activities, dewatering activities, and riparian vegetation removal.

Pile driving, dewatering, capture, and handling result in fish behavioral modifications, entrainment, harm, injury or death. Riparian removal reduces primary productivity, decreases prey availability and increase the presence of predatory fish, leading to harm or death. NMFS anticipates incidental take will be limited to the following forms:

1) Take in the form of harm, injury and death to listed fish, due to pile driving. Expected impact thresholds for attenuated piles are as follows: The 150dB RMS behavioral threshold is expected to be 650 m from the pile resulting in stress to fish, interruptions in migration, increased predation and decreased feeding within this range. The 187dB cumulative threshold for injury to fish greater than 2g and the 183dB cumulative threshold for injury to fish less than 2g are expected to be 650 m from the pile. The peak 206dB threshold for injury is expected to be 18 m from the pile. Impacts to fish within this range includes injury or death. Due to the timing of the activity, actual numbers for each species is expected to be low.
2) Take in the form of harm, injury and death to listed fish, due to handling during relocation, stranding, or entrainment during pile-driving activities. NMFS estimates that no more than 2 juvenile or subadult sDPS green sturgeon, 1 adult green sturgeon, 3 juvenile CCV steelhead, and/or 1 adult CCV steelhead may become entrained within the cofferdam or 60-inch piles.
3) Take in the form of harm to listed fish from loss and degradation of riparian habitat leading to injury and death by creating habitat conditions that decrease productivity and prey availability and increase predation associated with the riparian removal and new bridge components. The total area of permanent riparian vegetation removal is 0.09 acres.

If monitoring indicates that sound levels greater than 206 dB peak, 187 dB or 183 dB cumulative SEL, or 150 dB RMS extend beyond the above described expected distances for pile size and attenuation type, work should stop and NMFS should be contacted within 24 hours, to determine if incidental take has been exceeded, or if sound levels can be reduced. If the above described area for riparian removal are exceeded, the anticipated incidental take level described would be exceeded, triggering the need to reinitiate consultation.

2.9.2. Effect of the Take

In this 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" (RPMs) are measures that are necessary or appropriate to minimize the impact of the amount or extent of incidental take (50 CFR 402.02). RPMs for this project are:

1) Hydroacoustic attenuation devices shall be implemented to minimize noise generated by pile-driving activities.
2) Fish rescue operations shall be conducted according to the specifications provided to NMFS and the NMFS-approved supervising biologist (s) will oversee all aspects of dewatering and fish handling operations.
3) Caltrans shall report any incidence of take to NMFS within 24 hours.
4) Caltrans shall provide a report of project activities to NMFS by December 31 of the construction year.

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. Caltrans 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 lapse.

1) The following terms and conditions implement reasonable and prudent measure 1:
    a. Acoustic attenuation devices shall be used for all in-water pile driving, these devices shall be routinely inspected for proper installation, operation, and functionality.
    b. Sound monitoring shall occur to ensure that sound pressure levels generated by pile-driving activities are not exceeding those included in the incidental take statement above.
2) The following terms and conditions implement reasonable and prudent measure 2:
    a. If they are to occur, all aspects of fish rescue operations shall be supervised by at least one NMFS-approved biologist who will be personally on site throughout each phase of the rescue operation.
    b. A written plan for a fish rescue operation specific to this project shall be established prior to implementation of the project. The plan shall be thoroughly understood by all individuals that are to be involved and operations shall be conducted in strict accordance with the written plan.
3) The following terms and conditions implement reasonable and prudent measure 3:
    a. Caltrans shall record the date, number, and specific location of all listed fish that are relocated for each construction-related activity in the project area in addition to any direct mortality observed during in-water work and relocation. If a listed species is observed injured or killed by project activities, Caltrans shall contact NMFS within 24 hours at 916-930-3600. Notification shall include species identification, the number of fish, and a description of the action that resulted in take.
4) The following terms and conditions implement reasonable and prudent measure 4:
    a. This report shall include a summary description of in-water construction dates and activities, avoidance and minimization measures taken, and restored areas on-site. Updates and reports required by these terms and conditions shall be submitted by December 31 of each year during the construction period to:

       Assistant Regional Administrator
       NMFS – WCR – California Central Valley Office
       650 Capitol Mall, suite 5-100
       Sacramento, CA 95814

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) Caltrans should purchase mitigation credits at a NMFS-approved conservation bank within critical habitat for the listed fish species discussed in this opinion at a 2:1 ratio for temporary losses and 3:1 ratio for permanent impacts to critical habitat in the action area associated with this project. Purchase of NMFS-approved conservation bank credits will offset habitat impacts to listed species consistent with agency requirements set forth in section 7(a)(1).
2) Caltrans 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 and sturgeon habitat restoration projects within the Sacramento River Basin. Implementation of future restoration projects is consistent with agency requirements set forth in section 7(a)(1).
3) Caltrans should limit the amount of riprap used for bank and in-stream protection in the Central Valley to the minimum amount needed for erosion and scour protection and bench design. Engineering plans shall be provided to the contractors that clearly show the amount of riprap to be placed at the project site. Limitation of riprap in design considerations is consistent with agency requirements set forth in section 7(a)(1).
4) Caltrans should consider using alternative methods to traditional rock slope protection for bridge projects and incorporating geotextiles for bank erosion control and prevention. Bioengineered products are available on the market and can be used to protect areas against erosive forces along shorelines and is an alternative to using riprap. Implementation of riprap alternatives in design considerations is consistent with agency requirements set forth in section 7(a)(1).

2.11. Reinitiation of Consultation

This concludes formal consultation for the Miner Slough Bridge Replacement Project Reinitiation 2021.

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 Caltrans 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

EFH designated under the Pacific Coast Salmon Fisheries Management Plan (FMP) may be affected by the Proposed Action. Additional species that utilize EFH designated under this FMP within the Action Area include fall-run/late fall-run Chinook salmon. Habitat Areas of Particular Concern (HAPCs) that may be either directly or indirectly adversely affected include (1) complex channels and floodplain habitats, and (2) estuaries.

3.2. Adverse Effects on Essential Fish Habitat

Effects to the HAPCs listed in section 3.1 above are discussed in context of effects to critical habitat PBFs as designated under the ESA in section 2.5.2. Effects to ESA-listed critical habitat and EFH HAPCs are appreciably similar, therefore no additional discussion is included. A list of adverse effects to EFH HAPCs is included in this EFH consultation. Affected HAPCs are indicated by number corresponding to those identified as present in the action area in section 3.1:

- Sedimentation and turbidity
    - Reduced habitat complexity (1, 2)
- Bridge Installation and Removal of Existing Bridge
    - Degraded water quality (2)
    - Permanent loss of wetland habitat (1)
    - Reduction in aquatic macroinvertebrate production (1)

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) Caltrans 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 and sturgeon habitat restoration projects within the Sacramento River Basin. HAPCs that would benefit from this include (1) complex channels and floodplain habitats, and (2) estuaries.
2) Caltrans should limit the amount of riprap used for bank and in-stream protection in the Central Valley to the minimum amount needed for erosion and scour protection and bench design. Engineering plans shall be provided to the contractors that clearly show the amount of riprap to be placed at the project site. HAPC complex channels and floodplain habitats would benefit from this.
3) Caltrans should consider using alternative methods to traditional rock slope protection for bridge projects and incorporating geotextiles for bank erosion control and prevention. Bioengineered products are available on the market and can be used to protect areas against erosive forces along shorelines and is an alternative to using riprap.

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, Caltrans 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

Caltrans 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 biological opinion addresses these DQA components, documents compliance with the DQA, and certifies that this biological 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 biological opinion are Caltrans and the FHWAS Other interested users could USFWS; CDFW; FHWG; Delta Stewardship Council; and other federal, state, and local government entities or NGOs involved in Delta fish and wildlife conservation. Individual copies of this biological opinion were provided to Caltrans. 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, if applicable, and reviewed in accordance with West Coast Region ESA quality control and assurance processes.

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