UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802

May 9, 2025 **Refer to NMFS No:** WCRO-2023-03444

Lindsay Vivian
Office Chief
California Department of Transportation, District 4
Office of Biological Sciences and Permits
P.O. Box 23660
Oakland, California 94623-0660

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Petaluma River Bridge Project (04-2Q500)

Dear Ms. Vivian:

Thank you for your letter of December 26, 2023, requesting initiation of consultation with NOAA's National Marine Fisheries Service (NMFS) pursuant to section 7 of the Endangered Species Act of 1973 (ESA) (16 U.S.C. 1531 et seq.) for the Petaluma River Bridge Project (04-2Q500).

Thank you also for your request for essential fish habitat (EFH) consultation. NMFS also reviewed the proposed action for potential effects on essential fish habitat (EFH) designated under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1855(b)). This review was pursuant to section 305(b) of the MSA, implementing regulations at 50 CFR 600.920, and agency guidance for use of the ESA consultation process to complete EFH consultation. NMFS concluded that the action would adversely affect EFH designated under the Pacific Coast Salmon, Coastal Pelagic, and Pacific Coast Groundfish Fisheries Management Plans. Therefore, we have included the results of that review in this document. While the proposed action will result in adverse effects to EFH, the proposed project contains measures to minimize, mitigate, or otherwise offset the adverse effects; thus, no EFH Conservation Recommendations are included in this opinion.

The enclosed biological opinion is based on our review of the California Department of Transportation's (Caltrans)[1] proposed project and describes NMFS' analysis of effects on threatened Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*) and threatened North American Green Sturgeon (*Acipenser medirostris*), and their designated critical habitat, in accordance with section 7 of the ESA. In the enclosed biological opinion, and based on the best

[1] Caltrans is acting as the lead agency for ESA Section 7(a)(2) and MSA Section 305(b) formal consultation under National Environmental Policy Act Assignment from Federal Highway Administration (327 Memorandum of Understanding (MOU) 2022 and 326 MOU 2022). As assigned by the MOUs, Caltrans is responsible for the environmental review, consultation and coordination on this project.

scientific and commercial information available, NMFS concludes that the proposed action is not likely to jeopardize the continued existence of the CCC steelhead Distinct Population Segment (DPS) and the North American Green Sturgeon (DPS), nor is the project likely to destroy or adversely modify designated critical habitat for CCC steelhead and North American Green Sturgeon. However, NMFS anticipates take of North American Green Sturgeon and CCC steelhead. An incidental take statement with terms and conditions is included within the enclosed biological opinion.

Please contact Elena Meza of the NMFS North-Central Coast Office in Santa Rosa, California at (707) 531-0706, or elena.meza@noaa.gov if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Penny Ruvelas
Assistant Regional Administrator
California Coastal Office

Enclosure

cc: David Weber, Caltrans, David.weber@dot.ca.gov
efile: 151422WCR2023SR00270

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

Petaluma River Bridge Project (04-2Q500)
NMFS Consultation Number: WCRO-2023-03444
Action Agency: California Department of Transportation (Caltrans)

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	If likely to adversely affect, Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	If likely to adversely affect, is Action Likely to Destroy or Adversely Modify Critical Habitat?
Central California Coast (CCC) steelhead DPS (*Oncorhynchus mykiss*)	Threatened	No	No	Yes	No
North American green sturgeon Southern DPS (*Acipenser medirostris*)	Threatened	Yes	No	Yes	No

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

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

Issued By: Penny Ruvelas
Penny Ruvelas
Assistant Regional Administrator
California Coastal Office

Date: May 09, 2025

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1. INTRODUCTION

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

1.1. Background

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

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

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

1.2. Consultation History

By letter dated December 26, 2023, Caltrans requested initiation of formal consultation under the ESA and provided NMFS the Petaluma River Bridge Project Biological Assessment (BA). The BA included the following: hydroacoustic analysis and assessment, reconnaissance field surveys, preliminary project plans for construction, and several project figures.

- December 12, 2023: Caltrans submitted a BA to NMFS on December 12, 2023.
- February 13, 2024: NMFS requested clarification on a catchment system, bioretention swale construction, the hydroacoustic assessment and vibratory hammer via electronic mail message.
- February 15, 2024: Caltrans responded to the clarification. Caltrans confirmed commitment to debris catchment and bioretention swale via electronic mail message.
- March 8, 2024: NMFS requested additional information on the staging area and bioswale via electronic mail message.
- March 8, 2024: Caltrans responded to request for additional information via electronic mail message.
- March 21, 2024: Caltrans and NMFS conducted a site visit. NMFS requested additional information on the in-kind drainage facility and bioswale in-person. Caltrans responded to request for additional information via electronic mail message. Sufficient information was provided to initiate consultation.

- April 30, 2024: NMFS requested clarification on stormwater impacts and treatment via electronic mail message.
- May 30, 2024: Caltrans responded to the clarification.
- June 18, 2024: Caltrans received an insufficiency letter from NMFS.
- July 31, 2024: NMFS and Caltrans have an interagency meeting to discuss stormwater treatment and impacts.
- August 1, 2024: NMFS and Caltrans agree on a request for an extended date to complete the signed biological opinion by October 29, 2024.
- August 26, 2024: NMFS receives a response letter from Caltrans.
- January 14, 2025: Caltrans provides updated plans on additional stormwater treatment for the project via electronic mail message.
- March 25, 2025: NMFS reviewed information provided by Caltrans on January 14, 2025 and determined there was sufficient information to initiate the consultation.
- April 2, 2025: NMFS notified Caltrans via phone that consultation was initiated on January 14, 2025.

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

1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies (see 50 CFR 402.02). 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).

Caltrans proposes to rehabilitate and repair sections of the Petaluma River Bridge to improve the structural integrity to meet current design standards for safety and to prolong its use in the future. The bridge is located in Marin and Sonoma Counties on State Route 37 (SR 37) between post mile (PM) 14.0 and 0.5, and is a 29-span structure with a pavement surface comprised of a 2-inch-thick layer of asphalt over a concrete deck, overlaid with asphalt concrete. The existing annual average daily traffic (AADT) volume for the Petaluma River Bridge can be characterized as high[2] (Caltrans 2024).

[2] High AADT: over 10,000 vehicles per day, Medium AADT: 1,000 – 10,000 vehicles per day, Low AADT: under 1,000 vehicles per day.

The project involves the following four main components: 1) bridge deck rehabilitation; 2) bridge rail replacement; 3) bridge fender system replacement; and 4) stormwater treatment and drainage improvement.

1.3.1. Bridge Deck Rehabilitation

The existing bridge deck is approximately 3.41 acres. The new bridge deck will be approximately 3.51 acres (an approximately 0.10 increase from the existing bridge deck). The top two inches of asphalt concrete pavement will be removed and replaced with a 4-inch layer of polyester concrete deck surfacing. The contractor will establish a debris catchment system to capture any debris from removal and installation of the bridge deck. New approach slabs will replace existing slabs at the east and west ends of the bridge. The existing pourable joint seals will be replaced with Type A finger joint seals. A portion of the existing median barrier will be removed to facilitate the replacement joints and replaced in-kind. Heavy equipment will be used on the roadway surface.

The crew will stage equipment northeast of the bridge in a 1.96-acre section adjacent to SR 37 throughout the project. The temporary staging area will be surrounded by a high-visibility fence and reinforced silt fence. No impacts to surrounding vegetation are expected to occur.

1.3.2. Bridge Rail Replacement

The existing 4,412 feet of concrete baluster will be replaced and upgraded with Type 85 concrete barrier along both sides of the bridge. The bridge will be widened by one foot on each side to accommodate the addition of each new railing. The metal beam guardrail approaches and departures will be replaced with Midwest guardrail system (MGS), with transition railing between the guardrail and the proposed bridge railing. To provide a standard connect between the MGS and the proposed bridge railing, 25 feet of the existing guardrail will be removed and replaced with the standard transition railing WB-31.

1.3.3. Bridge Fender System Replacement

The existing fender system consists of in-water creosote-treated wood fenders. The project will completely remove the existing fender system by vibrating and pulling piles from a barge-mounted crane. If complete pile removal is not possible with vibratory methods, wood piles will be cut and removed to three feet below the mudline. The new fender system will be comprised of 24-inch steel piles, 96 in total, and steel walers with plastic lumber sheathing. The piles will be installed at bridge bents 7 and 8. Each pile could take up to a maximum of 1,250 blows per pile to install, and the number of pile strikes per day will be limited to 2,000. With this daily strike limit imposed, each pile will take approximately 0.63 days to install; however, given the mud substrate within the action area, piles are expected to sink a considerable amount from the weight of the pile driving hammer head alone prior to initiating full power with the impact hammer. Thus, it is reasonable to expect that a pile could take less than the maximum amount of pile strikes to install. To complete construction, the 24-inch steel piles will first be vibrated in, then driven to tip with an impact hammer, then the remaining fender elements will be installed.

For fender system construction, equipment and materials will be transported from the Black Point Boat Launch area located to the south of the bridge. One barge will hold the crane and other construction equipment, while one or more barges will be used to hold supplies or transport materials from the boat ramp to the working barge. The work area around the existing and new fender system will first be enclosed in materials to minimize construction disturbance, including at minimum a sediment boom to contain suspended sediment, and a bubble curtain to reduce hydroacoustic pressure pulses.

Equipment used for project activities within the river include temporary barges, cranes, impact pile driver, vibratory pile driver, trucks, lifts, generators, hoe rams, jackhammers/breakers, dump trucks, and saw-cut machines.

1.3.4. Drainage Improvements and Stormwater Treatment

The existing bridge deck (3.41 acres) does not provide stormwater treatment, and untreated roadway runoff from the facility makes its way into the surrounding habitats. Following completion of the project, impervious surfaces will be increased by 0.10 acres. The new bridge deck impervious surface area would be 3.51 acres. Improvements will be made to drainage conveyance facilities as described below.

Drainage facilities on the west and east ends of the bridge will be constructed to convey stormwater into the adjacent area. One new inlet will be installed in the median and one in the eastbound direction in the roadway west of the approach slab. The inlets will be connected to each other by a corrugated steel pipe. A down drain on the surface of the hillside slope will be connected to the inlet in the eastbound direction and an existing inlet at the toe of the slope. Runoff conveyed in the corrugated steel pipe will drain into an existing inlet on the west side of Harbor Drive. Flow will then be conveyed across Harbor Drive via an existing underground concrete pipe which outlets into an existing unlined ditch on the east side. The existing unlined ditch conveys flows to the Petaluma River.

On the east side, a new system will be installed in both the eastbound and westbound directions to intercept runoff from the bridge. The system in the westbound direction includes an inlet in the outside shoulder east of the approach slab, a plastic pipe that drains to another inlet in the outside shoulder. A plastic pipe with a flared end section then outlets at the toe of the slope into an unlined trapezoidal ditch that drains to a larger ditch, just beyond the right of way. The system in the eastbound direction is similar with an inlet in the outside shoulder east of the approach slab and a plastic pipe that drains to another inlet in the outside shoulder. A plastic pipe with a flared end section then outlets at the toe of the slope into an unlined trapezoidal ditch that drains to a ditch outside of Caltrans' right of way.

Stormwater treatment within the project area will be achieved through a bioswale that captures runoff from the west end of the bridge and two adjacent biofiltration strips (biostrip) that capture runoff from the roadway on the east end of the bridge. The biostrip along the west will be 414 feet long and 13 feet wide, and the biostrip along the east will be 551 feet long and 16 feet wide. The media depth of the incorporated soil mixture that will promote infiltration within both of the biostrips will be comprised of a 2-inch-deep compost mix and a 10-inch deep uniform blend of compost and native soil.

The western bioswale proposed will be 48-feet-long, 8-feet wide, and will contain infiltration and treatment media at a depth of 2.5 feet. This bioswale is integrated into an existing at-grade unlined ditch and is engineered to treat stormwater runoff discharge from the Petaluma River Bridge and SR 37 from the down drain being replaced as part of the project (described above). The western bioswale contains two underdrains with clean-outs. After passing through the bioretention swale the stormwater exits into an existing unlined ditch where it will be carried under Harbor Drive by the existing drainage inlet and culvert. From there, runoff will be discharged into a vegetated channel that eventually leads to the Petaluma River. The bioswale was designed to include 4 parts sand, 2 parts compost, and 1-part topsoil by volume to achieve a hydraulic conductivity of at least 5 inches per hour. To maintain this conductivity the compost will be a fine particle size and the topsoil dry weight percentage must be 60 to 90 percent sand, with less than 20 percent passing the No. 200 sieve. Following construction, the proposed bioswales described above will treat approximately 33 percent of the 3.51 acres of impervious surfaces that currently drain into the surrounding habitat untreated.

1.3.5. Avoidance and Minimization Measures

Caltrans proposes to include several avoidance and minimization measures (AMMs) that will be implemented before, during, and after construction to prevent and minimize project-related effects to green sturgeon and steelhead, and the surrounding habitat. These measures include: working within the in-water work window of June 1 to October 31; limiting piles strikes to no more than 2,000 strikes per day and during September 1 to October 31 to avoid peak migration periods of listed species; preventing introduction of contaminants into waterways using a debris catchment system; waste management/materials pollution control, and development of a stormwater pollution prevention plan, and a stormwater management plan. A detailed list of the AMMs and additional best management practices (BMPs) are described in Caltrans' biological assessment (2023).

The applicant also proposes the following AMMs specific to pile driving and hydroacoustic impacts:

- Caltrans will monitor in-water sound pressure levels during installation of all piles;
- All in-water impact pile driving in water depths greater than 2 feet at any time will use an underwater sound pressure attenuation system (i.e., bubble curtain);
- Prolonged, soft-start procedures will be implemented when impact pile driving is required in water. Soft-starts will include pile driving at 40 – 60 percent reduced energy for at least 15 seconds, followed by a 1-minute waiting period. This procedure will be repeated at least two times before commencing full-energy impact pile driving.

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

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

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

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

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

- Evaluate the environmental baseline of the species and critical habitat.

- Evaluate the effects of the proposed action on species and their critical habitat using an exposure–response approach.

- Evaluate cumulative effects.

- In the integration and synthesis, add the effects of the action and cumulative effects to the environmental baseline, and, in light of the status of the species and critical habitat, analyze whether the proposed action is likely to: (1) directly or indirectly reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species; or (2) directly or indirectly result in an alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of a listed species.

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

2.1.1. Use of Best Available Scientific and Commercial Information

To conduct the assessment presented in this opinion, NMFS examined an extensive amount of information from a variety of sources. Detailed background information on the biology and status of the listed species and critical habitat has been published in a number of documents including peer reviewed scientific journals, primary reference materials, and governmental and non-governmental reports. Additional information regarding the potential effects of the proposed activities at the Petaluma River Bridge on the listed species in question, their anticipated response to these actions, and the environmental consequences of the actions as a whole was formulated from the aforementioned sources, and Caltrans biological assessment (2023).

Information was also provided in email messages and phone conversations between February 2024 and March 2025. For information that has been taken directly from published, citable documents, those citations have been referenced in the text and listed at the end of this document. A complete administrative record of this consultation is on file at the NMFS North-Coast Office in Santa Rosa, California (Administrative Record Number: 151422WCR2023SR00270).

2.2. Rangewide Status of the Species and Critical Habitat

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

2.2.1. Species Description and Life History

This biological opinion analyzes the effects of the federal action on the following Federally-listed species (Distinct Population Segment (DPS)) and designated critical habitat:

Central California Coast (CCC) steelhead (*Oncorhynchus mykiss*) DPS
Threatened (71 FR 834, January 5, 2006)
Critical habitat (70 FR 52488; September 2, 2005);

North American Green Sturgeon (*Acipenser medirostris*) Southern DPS
Threatened (71 FR 17757; April 7, 2006)
Critical habitat (74 FR 52300; September 8, 2008).

2.2.1.1 General Life History of Listed Species

2.2.1.1.1 CCC Steelhead

Steelhead are the anadromous form of *O. mykiss*, spawning in freshwater and migrating to marine environments to grow and mature. Steelhead have a complex life history that requires successful transition between life stages across a range of freshwater and marine habitats (i.e., egg-to-fry emergence, juvenile rearing, smolt outmigration, ocean survival, and upstream migration and spawning). Steelhead exhibit a high degree of life history plasticity (Shapovalov and Taft 1954; Thrower et al. 2004; Satterthwaite et al. 2009; Hayes et al. 2012). The occurrence and timing of these transitions are highly variable and generally driven by environmental conditions and resource availability (Satterthwaite et al. 2009; Sogard et al. 2012).

Adult steelhead spawn in gravel substrates with low sedimentation and suitable flow velocities. Females lay eggs in redds, where they are quickly fertilized by males and covered. Egg survival depends on oxygenated water circulating through the gravel, facilitating gas exchange and waste removal. Adults usually select spawning sites in pool-riffle transition areas of streams with gravel cobble substrates between 0.6 to 10.2 centimeters (cm) in diameter and flow velocities between 40 - 91cm per second (Smith 1973; Bjornn and Reiser 1991). Eggs incubate in redds for approximately 25 to 35 days depending on water temperature (Shapovalov and Taft 1954). Incubation time depends on water temperature, with warmer temperatures leading to lower incubation periods due to increased metabolic rates. Eggs hatch as alevin and remain buried in redds for an additional two to three weeks until yolk-sac absorption is complete (Shapovalov and Taft 1954). Optimal conditions for embryonic development include water temperatures between 6 and 10°C, dissolved oxygen near saturation, and fine sediments less than 5% of substrate by volume (Bjornn and Reiser 1991; USEPA 2001).

Upon emerging from redds, juvenile steelhead occupy edge water habitats where flow velocity is lower and cover aids in predator avoidance. Rearing juveniles feed on a variety of aquatic and terrestrial invertebrates. As they grow, juveniles move into deeper pool and riffle habitats where they continue to feed on invertebrates and have been observed feeding on younger juveniles (Chapman and Bjornn 1969; Everest and Chapman 1972). Juveniles can spend up to four years rearing in freshwater before migrating to the ocean as smolts, although they typically only spend one to two years in natal streams (Shapovalov and Taft 1954; Busby et al. 1996; Moyle 2002). Successful rearing depends on stream temperatures, flow velocities, and habitat availability. Preferred water temperature ranges from 12 to 19°C and sustained temperatures above 25°C are generally considered lethal (Smith and Li 1983; Busby et al. 1996; Moyle 2002; McCarthy et al. 2009). In Central California streams, juvenile steelhead are able to survive peak daily stream temperatures above 25°C for short periods when food is abundant (Smith and Li 1983). Response to stream temperatures can vary depending on the conditions to which individuals are acclimated, however, consistent exposure to high stream temperatures results in slower growth due to elevated metabolic rates and lower survival rates overall (Hokanson et al. 1977; Busby et al. 1996; Moyle 2002; McCarthy et al. 2009).

Juveniles undergo behavioral, morphological, and physiological changes in preparation for ocean entry, collectively called smoltification. Juveniles begin smoltification in freshwater and the process continues throughout downstream migration with some smolts using estuaries for further acclimation to saltwater prior to ocean entry (Smith 1990; Hayes et al. 2008). Juveniles typically will not smolt until reaching a minimum size of 160 mm (Burgner et al. 1992). Smoltification is cued by increasing photoperiod. Stream temperatures influence the rate of smoltification, with warmer temperatures leading to more rapid transition. Downstream migration of smolts typically occurs from April to June when temperature and stream flows increase. Preferred temperature for smoltification and outmigration is between 10 and 17°C with temperatures below 15°C considered optimal (Hokanson et al. 1977; Wurtsbaugh and Davis 1977; Zedonis and Newcomb 1997; Moyle 2002; Myrick and Cech 2005). In coastal systems with seasonal lagoons, smolts may take advantage of higher growth potential in productive lagoon habitats before ocean entry (Osterbeck et al. 2018).

Adult steelhead are known to be highly migratory during ocean residency but little is known of their habitat use and movements. They have been observed moving north and south along the continental shelf, presumably to areas of high productivity to feed (Barnhart 1986). Adults will typically spend one to two years in the ocean, feeding and growing in preparation for spawning (Shapovalov and Taft 1954; Busby et al. 1996). Upstream migration typically begins once winter rains commence and stream flows increase. For coastal systems with seasonal freshwater lagoons, winter storms are required to breech the sandbars and allow access to upstream spawning sites. Unlike most congenerics, steelhead are iteroparous, meaning they can return to spawn multiple times. Adult steelhead may spawn up to four times in their lifetime, although spawning runs predominantly consist of first-time spawners (~59%) (Shapovalov and Taft 1954). The maximum life span of steelhead is estimated to be nine years (Moyle 2002).

2.2.1.1.2 Green Sturgeon

Green sturgeon are an anadromous, long-lived, and bottom-oriented fish species in the family Acipenseridae. Sturgeon have skeletons composed mostly of cartilage and lack scales, instead possessing five rows of characteristic bony plates on their body called "scutes." On the underside of their flattened snouts are sensory barbels and a siphon-shaped, protrusible, toothless mouth.

Large adults may exceed 6 feet (2 meters) in length and 100 kilograms in weight (Moyle 1976). Based on genetic analyses and spawning site fidelity, NMFS determined that North American green sturgeon are comprised of at least two DPSs: a northern DPS consisting of populations originating from coastal watersheds northward of and including the Eel River ("northern DPS green sturgeon"), with spawning confirmed in the Klamath and Rogue river systems; and a Southern DPS consisting of populations originating from coastal watersheds south of the Eel River ("Southern DPS green sturgeon"), with spawning confirmed in the Sacramento River system (Adams et al. 2002).

Green sturgeon are the most marine-oriented species of sturgeon (Moyle 2002). Along the West Coast of North America, they range in nearshore waters from Mexico to the Bering Sea (Adams et al. 2002), with a general tendency to head north after their out-migration from freshwater (Lindley et al. 2011). While in the ocean, archival tagging indicates that green sturgeon occur in waters between 0 and 650 foot depth, but spend most of their time in waters between 65-260 feet (20–80 meters) and temperatures of 9.5–16.0°C (Huff et al. 2011, Nelson et al. 2010). Subadult and adult green sturgeon move between coastal waters and estuaries, but relatively little is known about how green sturgeon use these habitats. Lindley et al. (2011) report multiple rivers and estuaries are visited by aggregations of green sturgeon in summer months, and larger estuaries (e.g., San Francisco Bay) appear to be particularly important habitat. Adult Southern DPS green sturgeon enter San Francisco Bay in late winter through early spring, migrate upstream, and spawn from April through early July, with peaks of activity influenced by factors including water flow and temperature (Heublein et al. 2009, Poytress et al. 2015, Miller et al. 2020). Miller et al. (2020) showed that adult Southern DPS green sturgeon use the mainstem Sacramento River, Miner-Sutter Slough, and Steamboat Slough for upstream migration during spawning season. During the winter months, green sturgeon generally reside in the coastal ocean. Areas north of Vancouver Island are favored overwintering areas, with Queen Charlotte Sound and Hecate Strait likely destinations based on detections of acoustically-tagged green sturgeon (Lindley et al. 2008, Nelson et al. 2010).

Based on genetic stock identification (GSI) analyses, proportions between the northern and southern DPS differed spatially, with 48 percent of green sturgeon caught off the Oregon and Washington coasts and 96 percent of individuals caught off the California coast assigned to the Southern DPS from 2002-2019 (Richerson et al. 2022). This is corroborated by pairwise comparisons and genetic clustering analysis studies which reported that almost all green sturgeon collected in the San Francisco Bay system were Southern DPS (Israel et al. 2009).
Adult Southern DPS green sturgeon spawn in the cool sections of the upper mainstem Sacramento River watershed during the spring and early summer months (Moyle et al. 1995, Wyman et al. 2018). Eggs are laid in turbulent areas on the river bottom and primarily adhere to gravel or cobble substrates, or settle into the interstitial spaces (Adams et al. 2007, Poytress et al. 2011, Van Eenennaam et al. 2001). Like salmonids, green sturgeon require cool water temperatures for egg and larval development, with optimal temperatures ranging from 11 to 17˚C (Van Eenennaam et al. 2006). Eggs hatch after 6–8 days, and larval feeding begins 10–15 days post-hatch. Metamorphosis of larvae into juveniles typically occurs after a minimum of 45 days (post-hatch) when fish have reached 2- inches (60–80 millimeters (mm)) total length (TL). After hatching, larvae migrate downstream and metamorphose into juveniles. Juveniles spend their first few years in the Sacramento-San Joaquin Delta (Delta) and San Francisco Estuary before

entering the marine environment as subadults. Juvenile green sturgeon salvaged at the State and Federal water export facilities in the southern Delta are generally between 200 mm and 400 mm TL (Adams et al. 2002) which suggests Southern DPS green sturgeon spend several months to a year rearing in freshwater before entering the Delta and San Francisco Estuary. Laboratory studies conducted by Allen and Cech (2007) indicated juveniles approximately 6-month old were tolerant of saltwater, but approximately 1.5-year old green sturgeon appeared more capable of successful osmoregulation in salt water.

Subadult green sturgeon spend several years at sea before reaching reproductive maturity and returning to freshwater to spawn for the first time (Nakamoto et al. 1995). Little data are available regarding the size and age-at-maturity for the Southern DPS green sturgeon, but it is likely similar to that of the northern DPS. Male and female green sturgeon differ in age-at maturity.

Males can mature as young as 14 years and female green sturgeon mature as early as age 16 (Van Eenennaam et al. 2006). Adult green sturgeon are believed to spawn every two to five years. Recent telemetry studies by Heublein et al. (2009) indicate adults typically enter San Francisco Bay from the ocean and begin their upstream spawning migration between late February and early May. These adults on their way to spawning areas in the upper Sacramento River typically migrate rapidly through the estuary toward their upstream spawning sites. Preliminary results from tagged adult sturgeon suggest travel time from the Golden Gate to Rio Vista in the Delta is generally 1-2 weeks. Post-spawning, Heublein et al. (2009) reported tagged Southern DPS green sturgeon displayed two outmigration strategies; outmigration from Sacramento River prior to September 1 and outmigration during the onset of fall/winter stream flow increases. The transit time for post-spawning adults through the San Francisco Estuary appears to be very similar to their upstream migration (i.e., 1-2 weeks).

During the summer and fall, an unknown proportion of the population of non-spawning adults and subadults enter the San Francisco Estuary from the ocean for periods ranging from a few days to 6 months (Lindley et al. 2011). Some fish are detected only near the Golden Gate, while others move as far inland as Rio Vista in the Delta. The remainder of the population appear to enter bays and estuaries farther north from Humboldt Bay, California to Grays Harbor, Washington (Lindley et al. 2011).

Green sturgeon feed on benthic invertebrates and fish (Adams et al. 2002). Radtke (1966) analyzed stomach contents of juvenile green sturgeon captured in the Sacramento-San Joaquin Delta and found the majority of their diet was benthic invertebrates, such as mysid shrimp and amphipods (Corophium spp). Manual tracking of acoustically-tagged green sturgeon in the San Francisco Bay estuary indicates they are generally bottom-oriented, but make occasional forays to surface waters, perhaps to assist their movement (Kelly et al. 2007). Dumbauld et al. (2008) report that immature green sturgeon found in Willapa Bay, Grays Harbor, and the Columbia River Estuary, fed on a diet consisting primarily of benthic prey and fish common to these estuaries (ghost shrimp, crab, and crangonid shrimp), with burrowing thalassinid shrimp representing a significant proportion of the sturgeon diet. Dumbauld et al. (2008) observed feeding pits (depressions in the substrate believed to be formed when green sturgeon feed) in soft-bottom intertidal areas where green sturgeon are believed to spend a substantial amount foraging.

2.2.1.2 Status of Green Sturgeon and Critical Habitat

The Southern DPS of North American green sturgeon was listed as a federally threatened species in 2006 (71 FR 17757). The Southern DPS includes all spawning populations of green sturgeon south of the Eel River (exclusive), principally including the Sacramento River green sturgeon spawning population.

To date, little population-level data have been collected for green sturgeon. In particular, there are no published abundance estimates for either Northern DPS or Southern DPS green sturgeon in any of the natal rivers based on survey data. As a result, efforts to estimate green sturgeon population size have had to rely on sub-optimal data with known potential biases. Available abundance information comes mainly from four sources: 1) incidental captures in the CDFW white sturgeon monitoring program; 2) fish monitoring efforts associated with two diversion facilities on the upper Sacramento River; 3) fish salvage operations at the water export facilities on the Sacramento-San Joaquin Delta; and 4) dual frequency sonar identification in spawning areas of the upper Sacramento River. These data are insufficient in a variety of ways (short time series, non-target species, etc.) and do not support more than a qualitative evaluation of changes in green sturgeon abundance.

CDFW's white sturgeon monitoring program incidentally captures Southern DPS green sturgeon. Trammel nets are used to capture white sturgeon and CDFW utilizes a multiple-census or Peterson mark-recapture method to estimate the size of subadult and adult sturgeon population (CDFW 2002). By comparing ratios of white sturgeon to green sturgeon captures, estimates of Southern DPS green sturgeon abundance can be calculated. Estimated abundance of green sturgeon between 1954 and 2001 ranged from 175 fish to more than 8,000 per year and averaged 1,509 fish per year. Unfortunately, there are many biases and errors associated with these data, and CDFW does not consider these estimates reliable. For larval and juvenile green sturgeon in the upper Sacramento River, information is available from salmon monitoring efforts at the RBDD and the Glenn-Colusa Irrigation District (GCID). Incidental capture of larval and juvenile green sturgeon at the RBDD and GCID have ranged between 0 and 2,068 green sturgeon per year (Adams et al. 2002). Genetic data collected from these larval green sturgeon suggest that the number of adult green sturgeon spawning in the upper Sacramento River remained roughly constant between 2002 and 2006 in river reaches above Red Bluff (Israel and May 2010). In 2011, rotary screw traps operating in the Upper Sacramento River at RBDD captured 3,700 larval green sturgeon which represents the highest catch on record in 16 years of sampling (Poytress et al. 2011).

Juvenile green sturgeon are collected at water export facilities operated by the California Department of Water Resources (DWR) and the Federal Bureau of Reclamation (BOR) in the Sacramento-San Joaquin Delta. Fish collection records have been maintained by DWR from 1968 to present and by BOR from 1980 to present. The average number of Southern DPS green sturgeon taken per year at the DWR facility prior to 1986 was 732; from 1986 to 2001, the average per year was 47 (70 FR 17386). For the BOR facility, the average number prior to 1986 was 889; from 1986 to 2001 the average was 32 (70 FR 17386). Direct capture in the salvage operations at these facilities is a small component of the overall effect of water export facilities on Southern DPS green sturgeon; entrained juvenile green sturgeon are exposed to potential high levels of predation by non-native predators, disruption in migratory behavior, and poor habitat quality. Delta water exports have increased substantially since the 1970s and it is likely that this has contributed to negative trends in the abundance of migratory fish that utilize the Delta, including the Southern DPS green sturgeon.

A Southern DPS population estimate of 17,723 total individuals (95 percent confidence interval =12,614-22,482) was developed by Mora et al. (2018) through Dual Frequency Identification Sonar (DIDSON) surveys of aggregation sites conducted from 2010-2015 in the upper Sacramento River. The NMFS Southwest Fisheries Science Center has updated the total population estimate to 17,723 (Dudley 2021). The DIDSON surveys and modeling will eventually provide population trend data.

According to the NMFS (2021) 5-year status review 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. However, the species viability continues to be constrained by factors such as a small population size, lack of multiple populations, and concentration of spawning sites into just a few locations. The species continues to face a moderate risk of extinction. 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).

In August 2018, NMFS released a final Recovery Plan for the Southern DPS 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.

2.2.1.3 Status of CCC Steelhead Critical Habitat

In designating critical habitat, NMFS considers the following requirements of the species: 1) space for individual and population growth and for normal behavior; 2) food, water, air, light, minerals, or other nutritional or physiological requirements; 3) cover or shelter; 4) sites for spawning, reproduction, and rearing offspring; and 5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of the species (50 CFR 424.12(b)). In addition to these factors, NMFS also focuses on PBFs (formerly termed PCEs and/or essential habitat types) within the designated area that are essential to the conservation or protection (81 FR 7414).

PBFs for CCC steelhead critical habitat, and their associated essential features within freshwater include:

1. Freshwater spawning sites with water quantity and quality conditions and substrate supporting spawning, incubation and larval development.

2. Freshwater rearing sites with:

a. water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility;

b. water quality and forage supporting juvenile development; and

c. natural cover such as shade, submerged and overhanging large wood, log jams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks.

3. Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks supporting juvenile and adult mobility and survival.

The condition of CCC steelhead critical habitat, specifically its ability to provide for their conservation has been degraded from conditions known to support viable salmonid populations, and does not provide the full extent of conservation value necessary for the recovery of the species. NMFS has determined that currently depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat[3]: logging, agriculture, mining, urbanization, stream channelization, dams, wetland loss, and water withdrawals (including unscreened diversions for irrigation). Impacts of concern include altered stream bank and channel morphology, elevated water temperature, lost spawning and rearing habitat, habitat fragmentation, impaired gravel and wood recruitment from upstream sources, degraded water quality, lost riparian vegetation, and increased erosion into streams from upland areas (Weitkamp et al. 1995; Busby et al. 1996; 64 FR 24049; 70 FR 37160; 70 FR 52488). Diversion and storage of river and stream flow has dramatically altered the natural hydrologic cycle in many streams within steelhead DPSs. Altered flow regimes can delay or preclude migration, dewater aquatic habitat, and strand fish in disconnected pools while unscreened diversions can entrain juvenile fish. Similarly, land development had led to channelization of streams and placement of developed areas close to waterways.

2.2.2. Additional Threats to Green Sturgeon and CCC steelhead Critical Habitat

2.2.2.1 Global Climate Change

One factor affecting the range wide status of threatened CCC steelhead and Southern DPS of North American green sturgeon is climate change. Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level have all increased in California over the last century (Kadir et al. 2013). Snow melt from the Sierra Nevada has declined (Kadir et al. 2013). However, total annual precipitation amounts have shown no discernable change (Kadir et al. 2013). Recent work by the NMFS Science Centers ranked the relative vulnerability of west-coast steelhead to climate change and determined that CCC steelhead are moderate to high risk (Crozier et al. 2019). Green sturgeon

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

may have already experienced some detrimental impacts from climate change through lower and more variable stream flows, warmer stream temperatures, and changes in ocean conditions. NMFS believes the impacts on listed species to date are likely fairly minor because natural, and local climate factors likely still drive most of the climate conditions species experience, and many of these factors have much less influence on green sturgeon abundance and distribution than human disturbance across the landscape.

The threat to listed CCC steelhead and green sturgeon from global climate change is expected to increase in the future. Analysis of state-wide seasonal-mean temperature and modeling of climate change impacts in California suggests that average summer air temperatures are expected to continue to increase while fall air temperatures have exhibited temperature trend increase (Goss et al. 2020, Lindley et al. 2007, Moser et al. 2012). California experienced well below average precipitation during the 2012-2014 drought, as well as record high surface air temperatures in 2014 and 2015 (Williams et al. 2015). Heat waves are expected to occur more often, and heat wave temperatures are likely to be higher (Hayhoe et al. 2004, Moser et al. 2012, Kadir et al. 2013). Total precipitation in California may decline; critically dry years may increase (Lindley et al. 2007, Schneider 2007, Moser et al. 2012). Similarly, wildfires are expected to increase in frequency and magnitude (Goss et al. 2020, Moser et al. 2012). Increases in wide year-to- year variation in precipitation amounts (droughts and floods) are projected to occur (Swain et al. 2018). Paleoclimate reconstructions suggest the 2012-2016 drought was the most extreme in the past 500 to 1000 years (Williams et al. 2020, Williams et al. 2022). Anomalously high surface temperatures substantially amplified annual water deficits during 2012-2016. California entered another period of drought in 2020. These drought periods are now likely part of a larger drought event (Williams et al. 2022). This recent long-term drought, as well as the increased incidence and magnitude of wildfires in California, have likely been exacerbated by climate change (Williams et al. 2022, Diffenbaugh et al. 2015, Williams et al. 2019).

Rodgers et al. (2019) analyzed the mean effects of elevated temperatures, salinity, low food availability, and contaminants on growth as well as thermal tolerance, swimming performance, and heat shock protein expression. Elevated water temperature increased heat shock protein expressions and deformities while decreasing hatchling success. In the San Francisco Bay region, warm temperatures generally occur in July and August, but as climate change takes hold, the occurrences of these events will likely begin in June and could continue to occur in September (Cayan et al. 2012). Climate simulation models project that the San Francisco region will maintain its Mediterranean climate regime, but experience a higher degree of variability of annual precipitation during the next 50 years and years that are drier than the historical annual average during the middle and end of the twenty-first century. The greatest reduction in precipitation is projected to occur in March and April, with the core winter months remaining relatively unchanged (Cayan et al. 2012).

Estuaries may also experience changes detrimental to steelhead and green sturgeon. Estuarine productivity is likely to change based on changes in freshwater flows, nutrient cycling, and sediment amounts (Scavia et al. 2002, Ruggiero et al. 2010). In marine environments, ecosystems and habitats important to steelhead and sturgeon are likely to experience changes in temperatures, circulation, water chemistry, and food supplies (Brewer and Barry 2008, Feely 2004, Osgood 2008, Turley 2008, Abdul-Aziz et al. 2011, Doney et al. 2012). The projections described above are for the mid to late 21st Century. In shorter time frames, climate conditions not caused by the human addition of carbon dioxide to the atmosphere are more likely to predominate (Cox and Stephenson 2007, Smith et al. 2007, Santer et al. 2011).

2.2.2.2 Water Quality

Stormwater runoff from urban areas and roadways is a primary source of water quality degradation in aquatic habitats, including streams designated as CCC steelhead and green sturgeon critical habitat. Various pesticides, petroleum hydrocarbons, metals, and other toxic chemical contaminants common to commercial, industrial and residential land-use activities have been documented in stormwater runoff (Caltrans 2000, 2003a, 2003b). These chemicals are mobilized from roads, lawns, and other surfaces by rainfall or irrigation, and are transported to aquatic habitats via terrestrial runoff and discharges from stormwater conveyances (Good 1993). Recent studies have identified the degradation of some tire products as a causal factor in salmonid mortalities, even in concentrations of less than one part per billion (Tian et al. 2020). There are currently no published studies on green sturgeon effects. The identified contaminant, 6PPD-quinone (6PPD-q), has been found where both rural and urban roadways drain into waterways (Sutton et al. 2019). Studies have identified this issue and determined the cause of observed mortalities of adult and juvenile coho salmon in both field (Scholz et al. 2011) and laboratory settings respectively (Chow et al. 2019).

2.3. Action Area

"Action area" means all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action (50 CFR 402.02). The action area for the Petaluma River Bridge Project is approximately 186 acres of species habitat in Petaluma River and includes a 3,280-foot radius of the in-water habitat, and the surrounding riparian areas upstream and downstream of the Petaluma River from the fender system, and the areas that will become the bioretention swales.

2.4. Environmental Baseline

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

The Petaluma River was historically a narrow and shallow tidal slough that was dredged, widened, and straightened to facilitate the transport of goods for commercial ships beginning in the 1850s (Morrison et. al, 2014). The tidal slough was designated a river in 1959, which permitted the Army Corps of Engineers to conduct recurring dredging to maintain a navigable channel. The shoreline in this area consists of mixed-use agricultural development, suburban development, and recreational use. The Black Point Boat Launch is located on the west-end of the bridge where the public can launch their motor boats, kayaks, and canoes.

The Petaluma River Bridge has existed at its current location in Marin and Sonoma Counties, on State Route 37 at post mile 14.5 from Harbor Drive to Sears Point Road since 1958. The area is impacted by recreational activities; Black Point Boat Launch is a popular public launch frequented by users on motor boat, kayak, canoe, or paddle board. The subtidal area below the Petaluma River Bridge is periodically dredged to provide large vessels the ability to pass upstream to downtown Petaluma. The shoreline in this area consists of mixed-use agricultural development, suburban development, and recreational use.

The surrounding habitat includes tidally influenced salt marsh habitat, near-water flats, and upland grasses and scrub. Most of the area is inundated by high tides that influence the distribution and composition of Petaluma marsh vegetation, depending on the tidal channel network, size, and origin (Sanderson et. al, 2000).

The tidal portion of the Petaluma River is listed on the State of California's 2024 303(d) list of impaired waterbodies as impaired by excess nutrients, the pesticide diazinon, and high concentrations of nickel. Elevated levels of nickel are not unusual in the San Francisco Bay area due to geology. Elevated nutrient and diazinon levels may be due to numerous current or historical agricultural and livestock operations upstream of the project site as well as from the city of Petaluma located ~11.7 miles upstream or the Redwood Landfill (which currently produces compost) located along the Petaluma river ~3.7 miles upstream. Roadway associated contaminants may be introduced from the City of Petaluma as well as US Highway 101 (~11.7 miles upstream) and the existing infrastructure of Highway 37. It is unknown when the State of California last sampled the Petaluma River for contaminants.

2.4.1. Status of Listed Species in the Action Area

2.4.1.1 Steelhead

Spawning habitat is not likely present within the action area, and the Petaluma River functions primarily as a migration corridor for CCC steelhead. Limited information exists regarding the historic abundance of steelhead in the Petaluma basin, though the low elevations, gradient, valley confinement and the presence of a large marsh with connection to the San Francisco Bay suggests the population must have been plentiful (NMFS 2016a). In a 1962 report, steelhead were described as "lightly using" the Petaluma River (Skinner 1962). CDFW observations indicate that steelhead were historically found in Lichau, Adobe, and San Antonio creeks and possibly in Lynch, Willow Brook, and Thompson creeks. Of these tributaries, Adobe Creek has had the highest reported numbers of steelhead (e.g., a 1968 survey reported an estimated abundance of 150 juvenile steelhead per 30 meters (Leidy et al. 2005)). More current day information suggests that few tributaries in the watershed currently support steelhead (NMFS 2016a). UACG High School has monitored Adobe Creek (and other streams less frequently) in the Petaluma River watershed since the mid-80's. Numbers of spawners observed have ranged from a high of 60 in the mid-90’s to a low of zero from 2015 to 2017. In 2007, CDFW conducted thorough habitat surveys of major tributaries and confirmed presence of juvenile steelhead in most anadromous reaches. Recent declining trends in abundance also mirror declines in fish abundance elsewhere in the San Francisco Bay Diversity Strata. While survey effort has varied over the years, recently surveys have been more consistent with survey and data protocols following those of CDFW and NMFS. This is the most comprehensive survey effort in the Petaluma system, and indicates that steelhead abundance is far below what was seen 20 years ago. Given the proposed construction period for the project and the life history of steelhead, steelhead are expected to be present in the action area during construction activities.

2.4.1.2 Green Sturgeon

Adult green sturgeon pass through the San Francisco Bay estuary during spawning and post-spawning migrations. Pre-spawn green sturgeon enter the San Francisco Bay between late February and early May, and post-spawned adults travel to the bay prior to immigrating to the ocean (Heublein et al. 2009). Juvenile green sturgeon move into the Delta and San Francisco Estuary early in their juvenile life history, where they may remain for 2-3 years before migrating to the ocean (Allen and Cech 2007, Kelly et al. 2007). Out of 31 acoustically tagged juvenile green sturgeon monitored over a 9-month period, 15 individuals (48 percent) spent an average of 26.0 days residing in San Pablo Bay (Thomas et. al, 2022). With juvenile, sub-adult and adult green sturgeon utilizing both ocean and estuarine environments for foraging, these life stages of green sturgeon may be present in the Project’s action area throughout the year.

While no surveys of the action area were conducted to determine the presence of green sturgeon, multiple telemetry studies have previously detected the presence of green sturgeon within the action area. An acoustic telemetry study detected 29 adult green sturgeon at the Port Sonoma/Petaluma River mouth during all months of the year with the exception of November from 2009-2012 (Chapman et al. 2019). There was an increase in detections of adult green sturgeon from January through July, then a decrease through late summer and fall (Chapman et al. 2019). Out of 31 acoustically tagged juvenile green sturgeon monitored over a 9-month period, a single westernmost sturgeon was detected at the Petaluma River (Thomas et. al, 2022). Both adult and juvenile green sturgeon have been detected in the action area in recent years.

The San Francisco Bay Delta Estuary provides year-round rearing habitat for juveniles, as well as foraging habitat for non-spawning adults and subadults in the summer months (NMFS 2009c). Within the San Francisco Estuary, green sturgeon likely prey on demersal fish (e.g., sand lance (Ammodytes hexapterus)) and benthic invertebrates similar to those that green sturgeon are known to prey upon in estuaries of Washington and Oregon (Dumbauld et al. 2008). Green sturgeon are also known to be generalist feeders and may feed opportunistically on a variety of benthic species encountered. For example, the invasive overbite clam (Corbula amurensis) has become a common food of white sturgeon and green sturgeon in San Francisco Bay (CDFG 2002). Based on distribution data and foraging habits of green sturgeon, NMFS assumes they are present in the action area and likely foraging on benthic prey and fish commonly found in soft-bottom habitats (e.g., ghost shrimp, crab, and crangonid shrimp) of the San Francisco Estuary.

2.4.2. Status of Critical Habitat in the Action Area

The San Francisco Bay/Delta is one of the most human-altered estuaries in the world (Knowles and Cayan 2004). Major drivers of change in the action area that are common to many estuaries are water consumption and diversion, human modification of sediment supply, introduction of nonnative species, sewage and other pollutant inputs, and climate shifts. Responses to these drivers in the San Francisco Bay include shifts in the timing and extent of freshwater inflow and salinity intrusion, decreasing turbidity, restructuring of plankton communities, nutrient enrichment and metal contamination of biota, and large-scale food web changes (Cloern and Jassby 2012).

2.4.2.1 CCC Steelhead Critical Habitat

The action area for the Project is located within designated critical habitat for CCC steelhead. The PBFs for CCC steelhead in the action area include suitable food resources, water flow, water quality, water depth, and sediment quality. The Petaluma River watershed occupies 146 square miles and the lower river flows through 12 miles of tidal wetlands before emptying into San Pablo Bay. The functioning of critical habitat within the action area has been compromised largely by urban development (commercial, residential and roads), channel modification, and agriculture. Variables such as air temperature, wind patterns, and precipitation are likely influencing localized environmental conditions, such as water temperature, stream flow, and food availability. These local environmental conditions can affect the biology of listed species and the functioning of critical habitat and its value for conservation. The combination of climate change effects and effects of past and current human activities on local environmental conditions further reduce the current condition of available habitat for listed species in the action area. Within the action area, the Petaluma River provides suitable foraging and rearing habitat and a migration corridor.

2.4.2.2 Green Sturgeon Critical Habitat

The action area for the Project is located within designated critical habitat for the Southern DPS of green sturgeon. The PBFs for green sturgeon in the action area include suitable food resources, water flow, water quality, water depth, and sediment quality. The Petaluma River does not provide a known migration corridor to spawning habitat. The PBFs for green sturgeon critical habitat in the action area are degraded. Habitat degradation in the action area is primarily due to shoreline and subtidal development, shoreline stabilization, non-native invasive species, discharge and accumulation of contaminants, loss of tidal wetlands, and periodic dredging for navigation.

2.5. Effects of the Action

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

The following is expected to occur as a result from construction activities: 1) elevated underwater sounds; 2) decreased water quality during and post-construction; and 3) temporary and permanent loss of habitat. Construction activities associated with the proposed project may affect steelhead and green sturgeon, and their designated critical habitat. However, due to the absence of steelhead within the action area during construction, NMFS anticipates only post-construction effects (i.e., water quality and permanent habitat loss) will affect individual steelhead.

2.5.1. Underwater Sound

Elevated levels of underwater sound levels are expected during pile driving in tidal waters. Caltrans will install steel piles using an impact hammer to complete the fender system below the Petaluma River Bridge. Caltrans will utilize soft-start procedures before commencing full-energy impact pile driving. As described above, steelhead are not expected to be in the action area during pile driving activities. However, green sturgeon are expected to be in the action area year-round.

Green sturgeon may be injured or killed when exposed to impulsive sound sources such as those associated with pile driving of steel piles by impact hammers. Pathologies of fish associated with very high sound level exposure and very drastic changes in pressure are collectively known as barotraumas. These include hemorrhage and rupture of blood vessels and internal organs, including the swim bladder and kidneys. Death can be instantaneous, occur within minutes after exposure, or occur several days later. Fish can also die when exposed to lower, continuous sound pressure levels if exposed for longer periods of time. Hastings (1995) found death rates of 50 percent and 56 percent for gouramis (Trichogaster sp.) when exposed for two hours or less to continuous sounds at 192 decibels (dB) root-mean-square pressure (RMS) (re: 1micropascal [µPa]) at 400 Hertz (Hz) and 198 dB (re: 1[µPa]) at 150 Hz, respectively, and 25 percent for goldfish (*Carassius auratus*) when exposed to sounds of 204 dB (re: 1 µPa) at 250 Hz. Hastings (1995) also reported that acoustic "stunning", a potentially lethal effect resulting in a physiological shutdown of body functions, immobilized gourami within eight to thirty minutes of exposure to these sound levels.

Hearing loss in fishes can occur from exposure to high intensity sounds, which can overstimulate the auditory system of fishes and may result in temporary threshold shifts. A temporary threshold shift is considered a non-injurious temporary reduction in hearing sensitivity. Physical injury may also occur for fish exposed to high levels of continuous sound, manifested as a loss of hair cells, located on the epithelium of the inner ear (Hastings and Popper 2005). These hair cells are capable of sustaining injury or damage that may result in a temporary decrease in hearing sensitivity. However, this type of noise-induced hearing loss in fishes is generally considered recoverable, as fish possess the ability to regenerate damaged hair cells (Lombarte et al. 1993, Smith et al. 2006). Permanent hearing loss has not been documented in fish. Even if threshold shifts in hearing do not occur, loud sounds can mask the ability of fish to hear their environment. This effect from loud sound exposure is referred to as acoustic or auditory masking. Masking generally result from unwanted or unimportant sound impeding a fish's ability to hear sounds of interest, such as sounds made by prey or predators.

Underwater sound exposures have also been shown to alter the behaviors of fishes (see review by Hastings and Popper 2005). The observed behavioral changes include startle responses and increases in stress hormones. Exposure to pile driving sound pressure levels may also result in “agitation” of fishes indicated by a change in swimming behavior detected by Shin (1995) or “alarm” detected by Fewtrell (2003). Other potential changes include reduced predator awareness and reduced feeding. The potential for adverse behavioral effects will depend on a number of factors, including the sensitivity to sound, the type and duration of the sound, as well as life stages of fish that are present in the areas affected by underwater sound produced during pile driving. A fish that exhibits a startle response to a sudden loud sound may not necessarily be injured, but it is exhibiting behavior that suggests it perceives a stimulus indicating potential danger in its immediate environment. However, fish do not exhibit a startle response every time they experience a strong hydroacoustic stimulus.

In order the assess the potential effects to fish exposed to pile driving sound, a coalition of federal and state resource and transportation agencies along the West Coast, the Fisheries Hydroacoustic Working Group (FHWG), used data from a variety of sound sources and species to establish criteria for onset of injury to fishes from impact pile driving exposure (FHWG 2008). Most historical research has used peak pressure to evaluate the effects on fishes from underwater sound. Current research, however, suggests that sound exposure levels (SEL), a measure of the total sound energy expressed as the time-integrated, sound pressure squared, is also a relevant metric for evaluating the effects of sound on fishes. An advantage of the SEL metric is that the acoustic energy can be accumulated across multiple events and expressed as the cumulative SEL (cSEL). Therefore, a dual metric criteria was established by the FHWG and includes a threshold for peak pressure (206 dB) and cSEL (187 dB for fishes 2 grams or larger and 183 dB for fishes smaller than 2 grams). Injury would be expected if either threshold is exceeded. There is uncertainty as to the behavioral response to fish to underwater sound produced when driving piles in or near water. Until new information indicates otherwise, NMFS believes a 150 dB RMS threshold for behavioral responses for green sturgeon is appropriate.

Different types of piles (e.g., wood, steel, concrete) result in different levels of underwater sound when struck with a pile driver. Impact hammers produce the highest elevated underwater sound levels, particularly when used in combination with steel piles. In the updated Compendium of Pile Driving Sound Data (Molnar, 2020), the most recent pile driving monitoring results are compiled in order to provide information regarding the potential levels of underwater sound pressure levels generated with the installation of different pile and hammer types. Several pile driving case studies conducted within the San Francisco Bay region using steel, concrete, and composite piles are included in the compendium. Impact hammers produce the highest elevated underwater sound levels, particularly when used in combination with steel piles. Vibratory hammers produce less peak sound pressure than impact hammers and are often employed as a measure to reduce the sound generated by pile driving, and in turn, the potential for adverse effects on fish (Molnar et al. 2020).

2.5.1.1 Pile Driving in Tidal Waters

As described above in Section 1.3.3 of this opinion the use of an impact hammer would be restricted to the period between September 1 and October 31, and during this time, pile driving will be limited to no more than 2,000 pile strikes per day. Despite the restricted in-water pile driving window, green sturgeon are expected to occur within the action area year-round, and are expected be exposed to the effects of pile driving during this two-month period. All green sturgeon expected to be present within the action area will be greater than 2 grams.

For the purposes of this analysis we have used the maximum distances peak SPLs and cSELs could travel as a reasonable worst-case scenario. The highest sound levels associated with construction of the project will occur during the driving of the 24-inch steel pipe piles with an impact hammer (Table 1).

To estimate the peak SPL and cSEL that will occur during pile driving to replace the fender system, Caltrans provided the information below in Table 1. NMFS also examined hydroacoustic monitoring results for similar sized piles presented in the Compendium of Pile Driving Sound Data (Buehler et al. 2015), and generated estimates with a spreadsheet model to estimate peak SPLs and cSELs at various distances from the source. The underwater sound estimates in Table 1 also incorporate sound attenuation by use of an air bubble curtain. Air bubble curtains are constructed by the placement of one or more horizontal concentric rings of perforated tubing around the pile. Air is pumped through the tubes and into the rings to emit a curtain of bubbles that encapsulate the pile. To optimize the sound attenuation capability of the curtain, the amount of bubbles and thickness of the curtain are maximized by adjusting the flow of compressed air delivered to the perforated tubing. Therefore, the sound level estimates presented in Table 1 include 5 dB of sound attenuation. It should be noted that the hydroacoustic monitoring of individual projects have reports sound attenuation levels from bubble curtains as high as 20 dB (Molnar et al. 2020); however, the implementation of bubble curtains and the corresponding attenuation are not consistent. Due to these inconsistencies, no more than 5 dB attenuation is recommended by Molnar et al. (2020) when estimating the sound attenuation benefits of air bubble curtains.

The analysis utilized by Caltrans predicts SPLs from a pile driven with an impact hammer to install the fender system could exceed the 206 dB peak single strike threshold for a distance of up to 13 feet. At this close range, several factors make it unlikely that listed green sturgeon will be adjacent to a pile during driving with an impact hammer. First, the placement of an air bubble curtain will occupy 5-10 feet of the radial distance immediately outward from the pile. Thus, equipment of the air bubble curtain itself will physically take up 5 – 10 feet immediately outward of the pile. Secondly, activation of the air bubble curtain immediately prior to the initiation of pile driving is expected to startle fish adjacent to the pile and likely result in a flight response. Additional noise will also be created by the air compressors operating the bubble curtain, and boats and barges containing the pile driving equipment, and crew operating immediately overhead on the water surface. This noise will likely be perceived by fish as a stimulus indicating potential danger in its immediate environment, thus green sturgeon are not expected to remain in the area directly adjacent to a pile during impact hammer driving. Thus, NMFS believes it is unlikely that sound pressure levels created by a single strike will result in injury or mortality of green sturgeon.

Table 1. Sound Levels Associated with Impact Hammer Pile Driving of 24-inch Steel Piles*

Pile Type & Size	Max Single Strike Peak at 33 ft (10m)	Accumulated SEL at 33 ft (10m)	Single Strike RMS at 33 ft (10m)	Distance (ft) to 206 dB peak	Distance (ft) to 187 dB accumulated SEL/day	Distance (ft) to 150 dB RMS
24-inch steel	200 dB	170 dB	180	13	705	3,280

*Assumes the use of an air bubble curtain

Although it is unlikely that sound levels associated with the single strike of an impact hammer on a 24-inch diameter pile will cause injury mortality, cSEL is expected to result in injury or mortality of green sturgeon and cSEL will extend for a significantly greater distance from the driven pile. The spreadsheet model predicts the extent of SPLs above a cSEL of 187 dB would extend up to a radial distance of approximately 705 feet from the pile, and encompass the active working area under and around bents 7 and 8 of the bridge. For purposes of this analysis, the zone of potential injury or mortality to threatened green sturgeon is associated with cSEL equal to or greater than 187 dB and is defined as the area in which fish could experience a range of barotraumas, including damage to the inner ear, eyes, blood, nervous system, kidney, and liver. These injuries have the potential to result in the mortality of an individual fish either immediately or later in time.

Based on the foraging behavior and movements of green sturgeon, the fish is expected to be within the action year-round. Thus, some individuals may be subjected to elevated sound levels during pile driving activities at the bridge. However, NMFS estimates that only a small number of threatened green sturgeon may be injured or killed by the proposed pile driving because few individuals are likely to be exposed to an accumulated SEL of 187 dB or greater. To incur injury or mortality, and individual would need to remain continuously within the zone of cSEL (see Table 1) for an extended period of time during pile driving. For this project, a green sturgeon would need to remain within 705 feet (25 acres) from the impact hammer for at least the 1,250 piles strikes needed to install one pile. If green sturgeon did stay within this area of impact, NMFS anticipates that it would leave the impact area during the initial soft-start of pile driving, during any pauses to adjust the pile driver before initiating full power of the pile driver, and/or during the break between installation and set up between one pile and the next. Given the aforementioned, and tidal currents and typical behavioral movements, NMFS expects few, if any, green sturgeon will remain stationary long enough to accumulate SEL that are expected to cause injury or mortality.

Although there are no data available to quantify the risk of exposure to the cSEL threshold of 187 dB, NMFS believes that, for the reasons stated herein, the potential risk of injury or mortality to green sturgeon is low. Most green sturgeon within the action are will be expected to temporarily disperse when exposed to elevated underwater sound pressures, or move with tidal currents and behavioral movements. The 25-acre zone of physical injury during pile driving is relatively small in comparison to the size of San Pablo Bay. Thus, the likelihood of an individual green sturgeon’s presence in the area subject to exceedance of the cSEL of 187 dB is low; the likelihood of injury or mortality is proportionate to the low likelihood of presence.

All other piles proposed for installation as part of the project will be performed with a vibratory hammer. Vibratory hammers use counter-rotating eccentric weights to transmit vertical vibrations into the pile, causing the sediment surrounding the pile to liquefy and allow the pile to penetrate the substrate. The vibratory hammer produces sound energy that is spread out over time and is generally 10 to 20 dB lower than impact pile driving (Buehler et al. 2015). Based on the results of hydroacoustic monitoring of vibratory hammer pile installations (Buehler et al. 2015), the sound levels generated by vibratory use at the bridge will be considerably below the injury and mortality thresholds for both single strike and cSEL, and no adverse effects to green sturgeon are anticipated.

Beyond the zone of potential injury mortality, sound levels are projected to exceed 150 dB RMS to a maximum distance of 3,280 feet during the impact driving of 24-inch steel piles. Fish may demonstrate temporary abnormal behavior within this zone during pile driving indicative of stress or exhibit a startle response. A fish that exhibits a startle response may not be injured, but display behavior that suggests it perceives a stimulus indicating potential danger in its immediate environment. The behavioral impact zone is approximately 120 acres for the 24-inch piles. If any green sturgeon enter or transit the behavioral impact zones as described above during pile driving, there could be behavioral reactions. Green sturgeon may avoid the area due to the elevated underwater sound levels. As noted above, many fish species demonstrate an avoidance reaction in the near-field (Dolat 1997). While behavioral impacts of ESA-listed fish during pile driving have not been specifically studied, NMFS anticipates that green sturgeon, like other fish studied, will exhibit startle and avoidance behavioral reactions. Due to the availability of habitat directly adjacent to the action area, and anticipated behavioral response, green sturgeon are expected to react to the sound produced by pile driving by swimming away from the action area. Adequate water depths and the open water area of San Pablo Bay adjacent to the action area will provide startled fish sufficient area to escape and elevated sound levels should not result in significant effects on these individuals. Areas adjacent to the action area provide habitat of similar or higher quality and provide adequate carrying capacity to support individual sturgeon that are temporarily displaced during the use of an impact hammer.

2.5.1.1.1 Disturbance to the Benthic Community

The installation and removal of pilings will disturb bottom sediments and disturb the associated benthic community in the action area. Benthic invertebrates that are directly in the footprint of the 96 piles may be injured or killed. Although information on green sturgeon foraging behavior and their prey organisms is limited, it is known that green sturgeon prey on demersal fish and benthic invertebrates in estuaries. Radtke (1966) analyzed stomach contents of green sturgeon captured in the Sacramento-San Joaquin Delta and found the majority of their diet was benthic invertebrates, such as mysid shrimp and amphipods.

Pile driving by this project is expected to remove some prey organisms for green sturgeon and foraging in the action area may be affected. However, the extent of impacts to the benthic community is expected to be small due to the very small are affected by an individual pile. Based on recovery rates for benthic disturbance in the scientific literature (Oliver et al. 1977, Watling et al. 2001) and the two month in-water construction time frame, impacts to the benthic community in the action area are expected to be minimal. Collie et al. (2000) reported some aquatic invertebrates re-colonize areas within a few months of a disturbance activity and this is expected at individual sites following the completion of pile installation.

Due to several factors, NMFS does not expect the temporary reduction of benthic prey in the action area will prevent green sturgeon from finding suitable forage at the quantities and quality necessary for normal behavior (e.g., maintenance, growth, reproduction). First, the area of benthic disturbance due to new pile installation is a small portion of the action area between bents 7 and 8. Secondly, many benthic organisms are likely to survive the disturbance associated with construction of the project. Thirdly, all pile driving and removals will occur under or immediately adjacent to the existing Petaluma River Bridge which is an area highly modified by maritime development and frequent dredging. Given the small portion of the action area disturbed, the likely availability of forage elsewhere in the action area, and the recovery of the benthic community after disturbance, NMFS expects impacts from benthic disturbance to green sturgeon will be insignificant.

2.5.2. Water Quality During Construction

2.5.2.1 Increased Sedimentation and Turbidity

High levels of turbidity may affect fish by disrupting normal feeding behavior, reducing growth rates, increasing stress levels, and reducing respiratory functions (Benfield and Minello 1996, Nightingale and Simenstad 2001). High turbidity concentrations can also reduce dissolved oxygen in the water column, result in reduced respiratory functions, reduce tolerance to disease, and can also cause fish mortality (Siglet et al. 1984, Berg and Northcote 1985, Gregory and Northcote 1993, Velagic 1995, Waters 1995). There is little direct information available to assess the effects of turbidity in San Francisco Bay estuary on juvenile or adult green sturgeon. However, this benthic species is well adapted to living in estuaries with a fine sediment bottom and is tolerant of high levels of turbidity, because they have adapted to forage for prey organisms in soft bottom sediments.

As piles are driven and removed from the bay floor, fine-grain sediments such as clay and silt material found within the action area will be disturbed and will generate increased levels of turbidity in the adjacent water column. Yet, Caltrans proposed to include a sediment boom to minimize these effects. The extent of turbidity plumes resulting from project construction following removal of the sediment booms will depend on the tide, currents, and wind conditions during pile driving activities. Based on similar observations of similar pile removal and installation activities in the San Francisco Bay, increased levels of suspended sediment and turbidity during pile driving are anticipated to be minor, localized, and short-term. With strong tidal currents in the action area, any elevated levels of suspended sediment or turbidity are anticipated to rapidly return to background levels after work ceases.

Based on the aforementioned description, and the use of the sediment boom, the extent and levels of turbidity associated with construction activities by the project are not expected to result in harm or injury, or behavioral responses that impair migration, foraging, or make green sturgeon more susceptible to predation. If sturgeon temporarily relocated from areas of increased turbidity, habitat of similar value is available upstream of the project, and within other areas of San Pablo Bay, that offer equal or better habitat value for displaced individuals. Adjacent habitat areas also provide adequate carrying capacity to support individual green sturgeon that are temporarily displaced during in-water construction activities that cause increases in turbidity. For these reasons, the potential effects of minor and localized areas of elevated turbidity associated with project construction are expected to be insignificant to green sturgeon.

2.5.2.2 Pollution from Hazardous Materials and Contaminants

As described above, water and sediment quality within the action area are affected by stormwater runoff, industrial activities, and other urban influences. Dillon and Moore (1990) reported that major pollutant sources for San Francisco Bay include the freshwater flow from the Sacramento-San Joaquin River systems, over 50 waste treatment plants, and about 200 industries which are permitted to discharge directly into the Bay (citing Luoma and Phillips 1988). By analyzing historical bathymetric surveys, Jaffe et al. (1998) estimated that 350×106 m^3 of sediments were deposited in San Pablo Bay between 1856 and 1951; but over two-thirds of this input consisted of hydraulic mining debris that accumulated in only 31 years between 1856 and 1887. Environmental contaminants discharged into aqueous systems tend to associate with particulate material in the water column and with consolidated bedded sediments. However, since the U.S. Environmental Protection Agency started the National Pollutant Discharge Elimination System in 1972, water quality in San Francisco Bay has improved considerably.

During the installation and removal of piles, bottom sediments will be suspended and contaminants may be released to the water column. However, based on the project description including the type of activities conducted, the abbreviated in-water work window for pile driving, and the equipment used, the suspended plumes of sediment and potential contaminants released during construction are expected to be localized and short-term. Any minor and localized elevations in contaminants which might result from those suspended plumes are expected to be quickly diluted by tidal circulation to levels that are negligible for green sturgeon. For these reasons, the potential effects are expected to be insignificant to green sturgeon.

Equipment refueling, fluid leakage, equipment maintenance, and construction activities near open waters pose some risk of contamination of aquatic habitat and subsequent injury or death to listed fish. Oils and similar substances from construction equipment can contain a wide variety of polycyclic aromatic hydrocarbons (PAHs) and metals. Both can result in adverse impacts to fish. The project, as part of its AMMs, will have in place spill prevention measures designed to avoid contamination from equipment refueling, leakage, maintenance or other activities. NMFS anticipates these proposed AMMs will adequately protect water quality and avoid adverse effects by contaminants on green sturgeon.

2.5.3. <u>Post-Construction Water Quality</u>

The proposed project would result in a wider bridge by adding approximately 0.10 acres of net new impervious surface areas to the Petaluma River Bridge. Currently, there is no stormwater treatment onsite, and untreated runoff makes it way from the bridge and into the surrounding habitats. Runoff from roadways has been shown to convey contaminants that are toxic to salmonids, including steelhead and coho salmon (McIntyre et al. 2018, Chow et al. 2019, Peter et al. 2018, Tian et al. 2020, Feist et al. 2018, French et al. 2022, Sutton et al. 2019). Pollutants associated with vehicular traffic are expected to originate from the impervious surface of the new bridge deck. Published work has identified stormwater from roadways and streets as causing a high percentage of rapid mortality of adult and juvenile coho salmon (Scholz et al. 2011; McIntyre et al. 2018, Chow et al. 2019) with mortality or symptoms of exposure noticeable within hours. Mortalities have now been directly linked to motor vehicle tires, which deposit the compound 6PPD and its abiotic transformation product 6PPD-q onto roads. 6PPD or [(N-(1, 3-dimethylbutyl)-N'-phenyl-p-phenylenediamine] is used to preserve the elasticity of tires. 6PPD can transform into the presence of ozone (O3) to 6PPD-q. 6PPD-q is ubiquitous to roadways (Sutton et al. 2019) and was identified by Tian et al. (2021) as the primary cause of urban runoff coho mortality syndrome described by Scholz et al. (2011). Subsequent examinations documented impacts to steelhead within a few hours and neither species recovered when transferred to clear water (Chow et al. 2019; French et al. 2022). The LC50 (the concentration at which 50 percent of the test organisms die) for juvenile coho (1+ years old) was established at an exceedingly low level (95 parts per trillion (ng/L) (Tian et al. 2022)) that is realistic and documented in the environment (Challis et al. 2021; Johannessen et al. 2022a). Subsequent examinations of younger coho salmon juveniles have found mortality at lower levels.

Greer et al. (2023) tested approximately 6-monthly-old coho juveniles and documented mortalities starting as low as 51.2 ng/L. They estimated an LC50 of 80.4ng/L and a LC5 of 20.7 ng/L. Lo et al. (2023) tested juvenile coho ~3 weeks post swim-up and estimated a LC50 at this life staged of 41 ng/L and a LC5 of 16.6 ng/L. There are few studies on steelhead thus far and no studies published examining sublethal effects on salmonids. Brinkmann et al. (2022) found a LC50 for a 2-year old *O. mykiss* of 1 part per billion (µg/L) and remains the only study found reporting fish details at this time. It is anticipated that younger *O. mykiss* are likely more vulnerable to toxic effects from 6PPD-q in a manner similar to coho salmon. EPA (2024) examined these studies and many others to establish a screening value concentration expected to be generally protective of 95 percent of freshwater species exposed to 6PPD-q for short durations (e.g., one hour or less). Data specific to green sturgeon is limited; however, considering the effects to salmonids and non-salmonid species presented above, we conservatively estimate that the exposure to these chemicals may also cause injury and mortality of green sturgeon.

Recent literature has shown that mortality can be prevented by infiltrating road runoff through soil media containing organic matter, which removed 6PPD-q and other contaminants (McIntyre et al. 2015; Spromberg et al. 2016; Fardel et al. 2020; WA State DOE 2022; Navicikis-Brasch et al. 2022; McIntyre et al. 2023; Rodgers et al. 2023). Research and corresponding adaptive management surrounding 6PPD is rapidly evolving.

Heavy metals such as copper and zinc, well documented contaminants in stormwater from roadways (Caltrans 2000; 2003a; 2003b; DTSC 2021), detrimentally affect salmonids at low environmentally realistic levels. Effects include decreased resistance of fishes to disease, hyperactivity, impair respiration, disrupt osmoregulation and calcium levels and/or impact olfactory performance leading to disruption in critical fish behaviors at concentrations that are at, or just slightly above, ambient concentrations (Hansen et al. 1999a; 1999b; Baldwin et al. 2003; Sandahl et al. 2007; McIntyre et al. 2012). High salinity (or hardness) levels give some protection against these effects. In addition to well-known adverse effects to fish and other aquatic life such as mortality at high concentrations and impacts to benthic macroinvertebrate populations (Eisler 2000), zinc disrupts the ability of aquatic organisms to regulate the concentration of calcium across cell membranes (Lall and Kaushik 2021, DTSC 2021). This may lead to issues with the development and maintenance of the skeletal system and fish scales, delayed and stunted growth, and/or atrophy (Lall and Kaushik 2021, DTSC 2021). Zinc has also been implicated as decreasing reproductive success in purple sea urchin and may be a particular issues for species whose reproductive strategies involve external fertilization and development, such as shellfish species predated upon by green sturgeon (DTSC 2021).

As described above, PAHs are known to be hazardous to aquatic life and are globally associated with motor vehicle traffic. Runoff from roadways and other impervious surfaces nearly always contain PAHs, and originate from vehicle exhaust fuel leaks and spills, oil and grease, and roadway sealants (McIntyre et al. 2016, DTSC 2022). PAHs are known to cause cancer, reproductive anomalies, immune dysfunction, impairment of growth and development, and other impairments in fish exposed to sufficiently high concentrations (Johnson et al. 1999, Karrow et al. 1999, Johnson 2000, Stehr et al. 2000, Johnson et al. 2002, Sherry et al. 2006).

As described above in Section 1.3, the project will treat roadway runoff associated with 1.16 acres of impervious surfaces through biostrips/bioswales. Unlike traditional stormwater collection and conveyance practices, such as storm drain systems with direct outfalls to waterways, vegetated filter strips at the edges of paved surfaces, vegetated swales, and bioswales/biostrips can collect and convey stormwater into soils with large amounts of organic matter that bind or otherwise remove contaminants from the stormwater before it reaches a stream (Caltrans 2003b, McIntrye et al. 2015). Bioswales and biostrips have a treatment rating of "high" as noted by the Washington State Department of Ecology (2022). As a result of the above, 33 percent of the impervious surface associated with the bridge deck (3.51 acres) will be treated. Despite the treatment proposed, 77 percent of untreated stormwater runoff will enter into the surrounding habitat, including the river. Thus, steelhead and green sturgeon will be will be exposed to untreated stormwater runoff originating from the bridge deck. Pollutants expected in untreated runway runoff are expected to include oil, grease, PAHs, and other toxic chemicals associated with tires. Concentration levels and toxicity will be seasonally affected by rainfall patterns and proximity to the bridge. While treatment of 33 percent of roadway runoff will lessen exposure of steelhead and green sturgeon to stormwater runoff contaminants, exposure is still reasonably certain to occur, and may result in injury and mortality.

We cannot accurately estimate the number of individual steelhead or green sturgeon that will experience injury or mortality from exposure to untreated stormwater runoff with a meaningful level of accuracy because the number of duration of stormwater runoff events cannot be accurately predicted or quantified, nor can the number of steelhead or green sturgeon that will be exposed during those events be accurately predicted. Furthermore, not all exposed individuals will experience immediate adverse effects. We expect that every year small numbers of steelhead and green sturgeon will experience some sublethal affects such as stress, impaired olfactory performance, and reduced prey consumption. Additional effects to some steelhead and green sturgeon associated with exposure to contaminants in stormwater may include avoidance behaviors that disrupt feeding and migratory behavior, reduced growth, impairment of essential behaviors related to successful rearing and migration, cellular trauma, physiological trauma, reproductive failure, and mortality. These effects could extend in the Petaluma River down to the confluence with San Pablo Bay. When mixed with waters of the bay, contaminant levels originating from the bridge crossing at the Petaluma River bridge are likely to be diluted to levels that no longer pose a risk to steelhead and green sturgeon.

2.5.4. Habitat Impacts

2.5.4.1 Habitat Loss

As described above in Section 2.5.1 of this biological opinion, elevated SPLs within the action area are expected to create a zone of behavioral impacts (i.e., sound levels greater than 150 dB RMS) that may result in a level of disturbance that causes green sturgeon to avoid using the area for foraging and migrating during pile driving. Assuming the worst-case scenario, elevated sound levels result in an adverse behavioral response during pile driving, and the action area is rendered unusable by green sturgeon during hours when pile driving operations are underway.

For the project's use of an impact hammer to install 24-inch steel piles, the area of behavioral effects may be as large as 3,280 feet surrounding the Petaluma River Bridge and this area may be avoided by green sturgeon for the duration of pile driving each day. Because steelhead will not be present within the action area during construction NMFS expects impacts from temporary habitat loss to steelhead will be discountable.

The action area is thought to provide foraging habitat for sturgeon because the site includes soft bottom subtidal habitat. Although pile driving will not exceed 2,000 pile strikes per day, this temporal loss of foraging area could have an adverse effect on PBFs for food resources and prey. During the total duration of pile driving each day (up to 2,000 strikes per day), green sturgeon may avoid foraging in portions of the action area. However, when pile driving concludes each day, this area and its food resources will again be fully accessible to green sturgeon. Due to the short duration of pile driving expected each day, this temporary impact is not anticipated to prevent sturgeon from finding suitable forage at the quantities and quality necessary for normal behavior.

2.5.4.2 Increased Overwater Shade

Overwater structures, such as docks and piers, are known to reduce growth of submerged aquatic vegetation, decrease primary productivity, alter predatory-prey interactions, change invertebrate assemblages, and reduce the density of benthic invertebrates (Helfman 1981, Glasby 1999, Struck et al. 2004, Stutes et al. 2006); all of which may lead to an overall reduction in the quality of fish habitat. Light reduction decreases the amount of energy available for photosynthesis by phytoplankton, benthic algae, and attached microalgae. These are important components of food webs supporting juvenile and adult green sturgeon. The project the will result in an increase of 0.02 acres in overwater structures, a minimal increase. Additionally, the bridge is oriented north/south within 45 degrees, which minimizes the amount of time and space under the dock is left shaded during the day. The area affected by the increase in overwater structure in the action area will be limited to sites immediately adjacent to the bridge which are subtidal habitat that is regularly dredged for navigation and disturbed by large vessel traffic. Due to this regular disturbance and water depth ranging from 8-14 feet, it is unlikely that submerged aquatic vegetation will become established in these subtidal areas. For the above reasons, the expansion of the bridge is not expected to degrade PBFs of designated steelhead and green sturgeon critical habitat in the action area.

2.6. Cumulative Effects

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

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

2.7. 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.

Southern DPS green sturgeon occur within the Petaluma River, and have experienced serious declines in abundance and long-term population trends that suggest a negative growth rate. Designated critical habitat for green sturgeon also occurs within the Petaluma River. Human-induced factors have reduced populations and degraded habitat, which is turn has reduced the population's resilience to natural events, such as droughts, floods, and variable ocean conditions. Global climate change presents another real threat to the long-term persistence of the population, especially when combined with the current depressed population status and human caused impacts.

2.7.1. Listed Species

As described in the Effects of the Action (Section 2.5), NMFS identified the following components of the project that may result in effects to green sturgeon: increased underwater sound, benthic disturbance, sedimentation and turbidity, pollution from hazardous materials and contaminants, stormwater runoff, habitat loss, and increased overwater shade. Of these, increased underwater sound and post-construction stormwater runoff has the potential to result in reduced fitness, injury, and/or mortality of green sturgeon. Similarly, the following components of the project that may result in effects to steelhead are pollution from hazardous materials and contaminants, stormwater runoff, and increased overwater shade. Post-construction stormwater runoff has the potential to result in reduced fitness, injury, and/or mortality of steelhead.

For short-term effects, climate change is not expected to significantly worsen existing conditions over the time frame considered in this biological opinion. Considering the above, we do not expect climate change to affect steelhead and green sturgeon in the action area beyond the scope considered in this biological opinion. For long-term effects, climate change would likely worsen conditions if total precipitation in California declines and critically dry years increase. These conditions would likely modify water quality and habitat. The overall reduction in habitat quality caused by the project is limited to a small area and, therefore, even if climate change reduced the overall habitat quality in the future, when combined with this proposed action any amplification in habitat degradation would be very small.

Threatened green sturgeon may be adversely affected by elevated underwater sound levels during the driving of the ninety-six 24-inch-diameter steel piles with an impact hammer. With the proposed use of an air bubble curtain to attenuate underwater sound levels, peak SPLs above 206 dB from a single strike will be limited to the area immediately adjacent to the pile (up to 13 feet from the pile). It is unlikely individual sturgeon will occur within this close proximity during construction activities since equipment is expected to startle fish away from the pile driving sites before pile driving initiates, and a bubble curtain will likely prevent fish from being located within 13 feet of the piles. However, the cSEL may result in injury or death to green sturgeon if individuals remain within a distance of 705 feet from the piles being driving for an extended period of time. NMFS expects the number of green sturgeon exposed to this effect to be small because the during of pile driving is short, the zone of physical injury is immediately adjacent to suitable habitat, and the abundance of green sturgeon in the action area is expected to be low. Behavioral effects during the driving of the 24-inch piles will be limited to a maximum of 2,000 pile strikes per day. This noise may discourage green sturgeon from utilizing the action area for foraging or passage during pile driving, but this area represents a small portion of the Petaluma River and the San Pablo Bay, and these habitat areas will become available again once the pile driving is completed each day.

The use of vibratory hammers to install piles and install cofferdams will not create underwater sound levels that are harmful to listed fish. Vibratory hammers generate lower sound levels with different wave forms than impact hammers (Buehler *et al*. 2015). During use of vibratory hammers, sound levels are not expected to exceed the dual metric criteria for injury and mortality of fish established by the FHWG (*i.e*., peak pressure of 206 dB and cSEL of 187 dB).

Vibratory hammers and impact hammers can also create noise that startle fish and result in temporary dispersal from habitats adjacent to work sites. Behavioral effects during impact hammer pile driving will extend up to 3,280 feet. The zone of behavioral effects will be less for vibratory hammers. If listed green sturgeon were to react behaviorally to the sound produced by vibratory pile driving, adequate water depths and areas within adjacent open waters of the San Pablo Bay are expected to provide fish sufficient area to disperse. When pile driving ceases each day, elevated underwater sound levels will conclude and these habitats will become available again without disturbance.

In addition to the adverse effects described above, we also consider the potential impacts from benthic disturbance, increased sedimentation and turbidity, habitat loss, and increased overwater shade. Increased sedimentation and turbidity in the pile driving area resulting in benthic disturbance will be contained within the sediment boom, and once removed, is expected to dissipate with the tidal cycle.

We expect that every year a small, unquantifiable number of steelhead and green sturgeon will experience sublethal effects including stress, impaired olfactory performance, and reduced prey consumption resulting from exposure to contamination from untreated roadway runoff. Effects associated with exposure to impaired habitat and contaminants in stormwater may include avoidance behaviors that disrupt feeding and migratory behavior, reduced growth, cellular trauma, physiological trauma, reproductive failure, and mortality. However, we anticipate that the harm, injury, and mortality that will be experienced by small numbers of steelhead and green sturgeon from untreated roadway runoff is unlikely to affect the CCC steelhead DPS and green sturgeon DPS because any individuals within the action area post construction likely represent a small percentage of steelhead and green sturgeon in the overall population. In addition, treatment of 33 percent of roadway runoff will be treated prior to entering the surrounding habitat, which will reduce the exposure to steelhead and green sturgeon in the area. Furthermore, other areas of the Petaluma River and San Pablo Bay are expected to continue to contribute to the population when steelhead and green sturgeon are injured or killed as a result of this project.

NMFS does not expect any of the aforementioned effects to combine with other effects in any significant way. Therefore, we do not expect the proposed project to affect the persistence or recovery of the CCC steelhead DPS and green sturgeon DPS. We based this conclusion on our findings above, which considered the status of the species, the environmental baseline, all of the potential effects of the action, and the cumulative effects.

2.7.2. Critical Habitat

Regarding future climate change effects in the action area, California could be subject to higher average summer air temperatures and lower total precipitation levels. Reductions in the amount of snow and rainfall would reduce stream flow levels in Northern and Central Coastal rivers. Estuaries may also experience changes in productivity due to changes in freshwater flows, nutrient cycling, and sediment amounts. For this project, construction activities will occur over the short term, and the above effects of climate change are not likely to be detected within that time frame. If the effects of climate change are detected, they will likely materialize as moderate changes to the current climate conditions within the action area. These changes may place further stress on steelhead and green sturgeon populations. The effects of the proposed action combined with moderate climate change effects may result in conditions similar to those produced by natural ocean-atmospheric variations (as described in the Environmental Baseline) and annual variations. The species is expected to persist throughout these phenomena, as they have in the past, even when concurrently exposed to the effects of similar projects.

Effects to critical habitat from the proposed project are expected to include temporary impacts during construction activities and altered habitat conditions post-construction from increased shading. During pile driving activities, habitat will be diminished temporarily and green sturgeon forage habitat will be reduced in area equal to the zone of potential impact temporarily. Critical habitat at the site will be permanently diminished as a result of the increased overwater shade and benthic fill (0.04 acres). However, the overall degradation of forage PBFs in the action area is minor or of limited extent and suitable forage habitat will remain. When added to the environmental baseline, cumulative effects, species status, the effects on critical habitat from the proposed action are not expected to appreciably reduce the quality and function of critical habitat of either the Southern green sturgeon DPS or the CCC steelhead DPS.

2.8. Conclusion

After reviewing and analyzing the current status of the listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, the effects of other activities caused by the proposed action, and the cumulative effects, it is NMFS' biological opinion that the proposed action is not likely to jeopardize the continued existence of steelhead or green sturgeon, nor destroy or adversely modify their designated critical habitat.

2.9. Incidental Take Statement

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

2.9.1. <u>Amount or Extent of Take</u>

The amount of extent of take described below is based on the analysis of effects of the action done in the preceding biological opinion. If the action is implemented in a manner inconsistent with the project description provided to NMFS, and as a result, take of list species occurs, such take would not be exempt from section 9 of the ESA. In the biological opinion, NMFS determined that incidental take is reasonably certain to occur as follows:

Take of listed green sturgeon may occur during impact pile driving activities necessary to complete installation of the new bridge fender system. NMFS is not able to estimate the specific number of green sturgeon that may be injured or killed within the action area during pile driving due to unfavorable habitat conditions and insufficient data to make any meaningful estimate. However, based on available information, we believe that very few green sturgeon will actually be injured or killed by elevated sound levels during pile driving. Due to the difficultly in quantifying the number of green sturgeon that could be affected by pile driving, a surrogate measure of take is necessary to establish a limit of take exempted by this incidental take statement. For this action, compliance with the expected elevated underwater sound levels during pile driving is the best surrogate measure for incidental take associated with project implementation. Therefore, NMFS will consider the extent of take exceeded if elevated sound levels during pile driving are greater than 206 dB peak or 187dB cSEL at the following specified distances below:

Pile Type & Size	Max Single Strike Peak at 33 ft (10m)	Accumulated SEL at 33 ft (10m)	Single Strike RMS at 33 ft (10m)	Distance (ft) to 206 dB peak	Distance (ft) to 187 dB accumulated SEL/day	Distance (ft) to 150 dB RMS
24-inch steel	200 dB	170 dB	180	13	705	3,280

Steelhead and green sturgeon in the Petaluma River are likely to be harmed by the untreated portion of stormwater runoff delivered to the river. 6PPD-q, along with other contaminants associated with vehicular traffic (oil, grease, PAHs, and metals) are expected to discharge into the river during intermittent stormwater runoff events. Steelhead and green sturgeon within the action area will be exposed during these events and experience sublethal effects including stress, impaired olfactory performance, reduced prey consumption, and mortality.

The best available indicator (i.e., surrogate) of harm, injury, or mortality to steelhead and green sturgeon is reflected in the spatial extent of the bridge deck that will generate stormwater runoff over the Petaluma River.

The best available indicator for the extent of take expected due to stormwater runoff from the bridge deck over the Petaluma River is the physical extent (i.e., acres) of contaminant generating surface at the bridge, as the amount of contaminants in stormwater is directly proportional to the amount of impervious surface discharging into the river. For this project, the new bridge deck (expanding by one foot on either side) is the physical extent of contaminant generating impervious surface that will result in delivering contaminants associated with vehicular traffic to aquatic habitat in the Petaluma River. Stormwater inputs will result in short-term reduction of water quality due to petroleum-related compounds and other contaminants that wash off the bridge deck, which are reasonably certain to cause harm and mortality to steelhead and green sturgeon depending on the level of exposure. The surrogate measures of incidental take identified can be reasonably and reliably measured and monitored and serves as a meaningful reinitiation trigger.

The extent of incidental take will, therefore, be considered exceeded if the bridge deck exceeds a total of 3.51 acres of impervious surface.

2.9.2. Effect of the Take

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

2.9.3. Reasonable and Prudent Measures

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

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of steelhead and green sturgeon:

1. undertake measures to minimize harm to steelhead and green sturgeon from construction of the project and degradation of aquatic habitat;

2. undertake measures to ensure that injury and mortality to green sturgeon resulting from pile driving activities is low; and

3. prepare and submit plans and reports regarding the results of the hydroacoustic monitoring.

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 likely lapse.

1. The following terms and conditions implement reasonable and prudent measure 1:
    a. Caltrans will allow any NMFS employee(s) or any other person(s) designated by NMFS to accompany field personnel to visit the project site during activities described in this opinion.
    b. Construction equipment must be checked each day prior to work within the in waterway and, if necessary, action will be taken to prevent fluid leaks. If leaks occur during in-water work, Caltrans or their contractors will contain the spill.
    c. Once construction is complete, all excess materials will be removed and disposed of at an appropriate disposal site.

2. The following terms and conditions implement reasonable and prudent measure 2:
    a. Monitor underwater sound levels during impact pile driving to evaluate effects of the project on green sturgeon:
        i. At least four weeks prior to the initiation of construction, Caltrans shall develop and submit to NMFS for review a hydroacoustic monitoring plan that includes underwater sound measurements at

various distance and depths from the impact pile driving operations. At minimum, the plan must include the following: 1) all hydrophones will be placed at least 1 meter (3.3 feet) below the surface; 2) if only one hydrophone is used, it will be placed 10 meters (33 feet) from the pile at midwater depth; 3) if more than one hydrophone is used to calculate the transmission loss over distance, water depth where the hydrophone will be located will be at least 3 meters (10 feet); and 4) if waters are less than 4 meters (13 feet) deep, a single hydrophone will be placed at midwater depth.

ii. A designated monitor shall be one-site daily while impact pile driving is taking place to ensure that the attenuation mechanism (to be determined by the contractor) is operating efficiently. Caltrans shall be prepared to maintain and repair whatever attenuation mechanism that is implemented if the system is not functioning properly and fully.

iii. No impact pile driving will occur at times when the attenuation mechanism is not functioning properly and fully.

iv. The following acoustic metrics shall be recorded at a distance of 10 meters: single strike, single strike SEL, and RMS. Post-analysis and calculation shall be determined as described in Underwater Noise Monitoring Template developed by the FHWG. If measured SPLs exceed the SPLs at the distances identified in Section 2.9.1 of this biological opinion, Caltrans shall take immediate action to reduce the level of effect and shall notify NMFS within 24 hours (contact Elena Meza at 707-531-0706 or elena.meza@noaa.gov).

v. Caltrans shall allow any NMFS employee(s) or any other person(s) designated by NMFS to accompany field personnel to visit the project site during the activities described in this biological opinion.

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

   a. Hydroacoustic Monitoring Report – Caltrans shall provide a written report to NMFS with 60 days of completion of each pile driving event necessary to complete the project. The report must contain, at minimum, the following information:

      i. Project related activities – the dates pile installation occurred and a description of any and all measures taken to minimize effects on green sturgeon (e.g., utilization of sound attenuation mechanism);

      ii. Summary of construction activities – dates construction began and ended; use of a sediment boom and any other measures to protect aquatic habitat; a description of the minimization measures taken to address any unanticipated issues; photographs, pre-, during, and post-construction; and any other relevant information;

      iii. Attenuation mechanism monitoring – a description of the methods used to monitor the functioning of the attenuation mechanism; a description of any events during which the attenuation mechanism was not functioning properly and fully; and a description of methods used to maintain or repair the attenuation mechanisms, if undertaken; and

iv. Hydroacoustic monitoring – a description of the methods used to monitor underwater sound levels during impact hammer use; the locations (depths and distance from point of impact) where monitoring was conducted; the total number of pile strikes per pile; total number of strikes per day; interval between strikes; the peak/SPL, RMS, and SEL per strike; and accumulated SEL per day.

b. Post-construction reports are to be submitted to NMFS North-Central Coast Office, Attention: North Coast Branch Supervisor, 777 Sonoma Avenue, Room 325, Santa Rosa, California 95404-6528.

2.10. Conservation Recommendations

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of the threatened and endangered species. Specifically, "conservation recommendations" are suggestions regarding discretionary measures to minimize or avoid adverse effects of a proposed action on listed species or critical habitat or regarding the development of information (50 CFR 402.02). NMFS has no conservation recommendations for this project.

2.11. Reinitiation of Consultation

This concludes formal consultation for the Petaluma River Bridge Project (04-2Q500). Under 50 CFR 402.16(a): "Reinitiation of consultation is required and shall be requested by the federal agency, where discretionary federal involvement or control over the action has been retained or is authorized by law and: (1) If the amount or extent of taking specified in the incidental take statement is exceeded; (2) If new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or (4) If a new species is listed or critical habitat designated that may be affected by the identified action."

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

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

This analysis is based, in part, on the EFH assessment provided by Caltrans and descriptions of EFH for the Pacific Coast Groundfish (Pacific Fishery Management Council (PFMC 2020)), Coastal Pelagic Species (CPS) (PFMC 1998), and Pacific Coast Salmon (PFMC 2014) contained in the fishery management plans (FMPs) developed by the PFMC and approved by the Sectary of Commerce.

3.1. Essential Fish Habitat Affected by the Proposed Action

Caltrans has determined that the proposed action would adversely affect EFH for various life stages of fish species managed under the Pacific Coast Groundfish, Coastal Pelagic, and Pacific Coast Salmon FMPs. This determination is based on the potential for Caltrans' project to result in disturbance to benthic habitat, increased turbidity, elevated in-water sound and vibration, and habitat modification. In addition, the action area includes areas designated as Habitat Areas of Particular Concern (HAPC) for various species of fish within the Pacific Coast Groundfish and Pacific Coast Salmon FMPs; estuaries and eelgrass are designated HAPC for these FMPs.

3.2. Adverse Effects on Essential Fish Habitat

NMFS determined the proposed action would adversely affect EFH for various life stages of fish species managed under the Pacific Coast Groundfish, Coastal Pelagic, and Pacific Coast Salmon FMPs through: 1) elevated levels of underwater sounds; 2) disturbance to benthic habitat; 3) habitat modification; and 4) impacts to water quality. The effects of the project's activities on EFH for the Pacific Coast Groundfish, Coastal Pelagic, and Pacific Coast Salmon FMPs are generally the same as that presented in Section 2.5 of the biological opinion above for green sturgeon.

3.3. Essential Fish Habitat Conservation Recommendations

Based on the information developed in our effect analysis (see preceding biological opinion), NMFS has determined that the proposed action would adversely affect EFH for Pacific Coast Groundfish, Coastal Pelagic, and Pacific Coast Salmon FMPs. Section 305(b)(4)(A) of the MSA authorized NMFS to provide EFH Conservation Recommendations that will minimize adverse effects of an activity on EFH. Although adverse effects are anticipated as a result of the proposed project, the proposed avoidance and minimization measures, and best management practices in the accompanying biological opinion are sufficient to avoid, minimize, and/or mitigate for the anticipated effects. Therefore, no additional EFH Conservation Recommendations are necessary that would otherwise offset the adverse effects to EFH.

3.4. 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 opinion addresses these DQA components, documents compliance with the DQA, and certifies that this opinion has undergone pre-dissemination review.

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are Caltrans or their contractors. The document will be available within two 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 contains more background on information sources and quality.

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

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

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