UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
777 Sonoma Avenue, Room 325
Santa Rosa, California 95404-4731

April 6, 2023 **Refer to NMFS No:** WCRO-2021-02887

James Mazza
Regulatory Division Chief
Department of the Army
San Francisco District, Corps of Engineers
450 Golden Gate Avenue
San Francisco, California 94102-3406

Re: Endangered Species Act Section 7(a)(2) Biological Opinion and Magnuson–Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Pacific Gas and Electric Company's Bay Area Operation and Maintenance Program (Corps File No. 2018-00490S)

Dear Mr. Mazza:

Thank you for your letters of November 10, 2021, and April 4, 2023, requesting 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 Pacific Gas and Electric Company's (PG&E) Bay Area Operation and Maintenance Program (O&M Program). PG&E has applied for a regional general permit (RGP) from the U.S. Army Corps of Engineers (Corps) pursuant to Section 404 of the Clean Water Act of 1972, as amended, 33 U.S.C. § 1344 *et seq*., and Section 10 of the Rivers and Harbors Act of 1899, as amended, 33 U.S.C. § 403 *et seq*. PG&E proposes to conduct routine maintenance activities on electrical and natural gas infrastructure in the nine-county San Francisco Bay Area.[1]

The enclosed biological opinion is based on our review of the information provided by PG&E and the Corps for O&M Program activities and describes our analysis of potential effects on threatened Central California Coast steelhead (*Oncorhynchus mykiss*), threatened California Central Valley steelhead (*O. mykiss*), endangered Sacramento River Winter-run Chinook salmon *(O. tshawystsha)*, threatened Central Valley Spring-run Chinook salmon (*O. tshawystsha*), threatened Southern Distinct Population Segment of North American green sturgeon (*Acipenser medirostris*), and their designated critical habitats in accordance with section 7 of the ESA. In this biological opinion, NMFS concludes the proposed O&M Program activities are not likely to jeopardize the continued existence of these ESA-listed steelhead, salmon and green sturgeon, nor is it likely to adversely modify their critical habitat. However, NMFS anticipates take of these species will occur during Program activities and an incidental take statement is included with the enclosed biological opinion.

[1] The nine Bay Area counties consist of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties.

NMFS has also found that the proposed O&M Program may affect, but is not likely to adversely affect threatened South-Central California Coast steelhead (*O. mykiss*), threatened California Coastal Chinook salmon (*O. tshawystsha*), endangered Central California Coast coho salmon (*O. kisutch*), and their designated critical habitat in accordance with section 7 of the ESA.

Thank you, also, for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson–Stevens Fishery Conservation and Management Act [16 U.S.C. 1855(b)] for this action. Based on NMFS' review, we concluded that the action would adversely affect EFH for species managed under the Pacific Coast Salmon, Pacific Coast Groundfish, and Coastal Pelagic Species Fishery Management Plans (FMP). Therefore, we have included the results of that review in Section 3 of the enclosed document.

Please contact Sara Azat at the California Coastal Office in Santa Rosa at sara.azat@noaa.gov or 707-575-6067 if you have any questions concerning this consultation, or if you require additional information.

Sincerely,

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Enclosure

cc: Greg Brown, Corps of Engineers, San Francisco, CA (gregory.g.brown@usace.army.mil)
Matt Brown, PG&E, Fresno, CA (mvb5@pge.com)
Copy to E-file FRN 151422WCR2021SR00227

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

Pacific Gas and Electric Company Bay Area Operation and Maintenance Program
NMFS Consultation Number: WCRO-2021-02887

Affected Species and NMFS' Determinations:

ESA-Listed Species	Status	Is Action Likely to Adversely Affect Species?	Is Action Likely to Jeopardize the Species?	Is Action Likely to Adversely Affect Critical Habitat?	Is Action Likely to Destroy or Adversely Modify Critical Habitat?
Central California Coast Steelhead (*Oncorhynchus mykiss)*	Threatened	Yes	No	Yes	No
California Central Valley Steelhead (*O. mykiss*)	Threatened	Yes	No	Yes	No
Sacramento River Winter-run Chinook (*O. tshawytscha*)	Endangered	Yes	No	Yes	No
Central Valley Spring-run Chinook (*O. tshawytscha*)	Threatened	Yes	No	Yes	No
North American Green Sturgeon (*Acipenser medirostris*)	Threatened	Yes	No	Yes	No
South-Central California Coast steelhead DPS (*O. mykiss*)	Threatened	No	NA	No	NA
California Coastal Chinook (*O. tshawytscha*)	Threatened	No	NA	No	NA
Central California Coast Coho Salmon (*O. kisutch*)	Endangered	No	NA	No	NA

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

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

Issued By: 

Alecia Van Atta
Assistant Regional Administrator
California Coastal Office

Date: April 4, 2023

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1. INTRODUCTION

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

1.1. Background

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 California Coastal NMFS office.

1.2. Consultation History

In 2017, the Pacific Gas and Electric Company (PG&E) finalized a Habitat Conservation Plan and obtained an ESA Section 10(a)(1)(B) incidental take permit from the U.S. Fish and Wildlife Service (FWS) for the Bay Area Operation and Maintenance Program (O&M Program). The FWS Section 10(a)(1)(B) permit authorized the incidental take of several terrestrial species and fairy shrimp. In 2019, PG&E began preparing an application for a regional general permit (RGP) from the U.S. Army Corps of Engineers (Corps) pursuant to Section 404 of the Clean Water Act of 1972, as amended, 33 U.S.C. § 1344 *et seq*., and Section 10 of the Rivers and Harbors Act of 1899, as amended, 33 U.S.C. § 403 *et seq*., for O&M Program activities in waters of the U.S in the nine Bay Area counties, consisting of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties.

PG&E with the assistance of a consultant team, prepared a draft biological assessment which evaluated the effects of O&M Program activities on listed species under the jurisdiction of the NMFS. The January 2020 administrative draft of this biological assessment was submitted by PG&E to NMFS for review and comment.

On June 4, 2020, PG&E, their consultants, and NMFS met via teleconference to discuss the scope of activities proposed for inclusion in the RGP.

NMFS and PG&E had several conference calls between August and December 2020 to discuss Program activities, scope of the programmatic consultation, and conservation recommendations.

On February 1, 2021, NMFS leadership met with PG&E representatives to discuss O&M Program activities and information needs for the NMFS-Corps section 7 consultation.

On March 9, 2021, PG&E provided a revised draft of the biological assessment for NMFS review, and discussions between NMFS, the Corps, and PG&E representatives continued through March, April and May 2021 regarding the scope of the consultation. Based on the information provided in the draft biological assessment it was determined that proposed O&M Program work in freshwater streams occurs primarily, but not exclusively, in ephemeral waterways that are not occupied by listed anadromous fish. In addition, the generalized descriptions of O&M activities in freshwater streams presented in the March 2021 biological assessment did not provide sufficient information for NMFS to assess potential effects on listed fish in freshwater areas. Therefore, the Corps, NMFS, and PG&E agreed to focus the consultation on O&M activities associated with electrical infrastructure in tidal waters because these activities are routinely permitted by the Corps and potential effects on listed fish are well understood and predicable.

A revised draft biological assessment was provided to NMFS on June 18, 2021, and discussions continued between NMFS and PG&E to clarify the project description, scope of activities, and development of avoidance/minimization measures.

By letter dated November 10, 2021, the Corps requested formal consultation with NMFS for PG&E's O&M activities within tidal waters and tidal wetlands of San Francisco Bay. With the consultation request, the Corps provided a biological assessment and EFH Assessment, prepared by Insignia Environmental and titled *National Oceanic and Atmospheric Administration - National Marine Fisheries Service Biological Assessment for the Regional General Permit for Pacific Gas and Electric Company's Bay Area Operation and Maintenance Program, October 2021* (BA).

During February, March and April 2022, NMFS, the Corps, and PG&E representatives exchanged information regarding the project description. Specifically, NMFS requested additional details on tower replacement and eelgrass avoidance measures from PG&E.

During August and September 2022, NMFS, the Corps and PG&E representatives exchanged information regarding pile driving and the proposed mitigation program. A revised biological assessment was submitted on September 9, 2022, to NMFS and the Corps for review.

On September 29, 2022, the Corps transmitted to NMFS the final biological assessment for PG&E's O&M Program activities in tidal waters. Due to a minor error in Table 12 of the biological assessment, a revision was made by PG&E's consultant team on September 30, 2022. The final biological assessment was transmitted to NMFS on September 30, 2022 (September 2022 Biological Assessment).

A revised version of the September 2022 Biological Assessment's Technical Appendix A was provided by PG&E to NMFS on November 22, 2022.

During December 2022, NMFS determined that additional information and conservation measures were required to assess gas line crossing activities within freshwater streams. On December 12, 2022, PG&E representatives provided the geographic coordinates for 482 gas pipeline crossings in the nine Bay Area counties project area. Review by NMFS staff determined that approximately 110 of these crossings overlap with listed fish and critical habitat. The NMFS review of gas line crossing locations also revealed that three additional listed fish species (*i.e.*, threatened California Coastal Chinook salmon, endangered Central California Coast coho salmon, and threatened South-Central California Coast steelhead) may be affected by the O&M Program.

Between January and March 2023, NMFS and PG&E continued work together to identify gas line crossing sites that may affect listed anadromous fish and develop conservation measures for these freshwater work locations. On April 4, 2023, a supplemental biological assessment was transmitted to NMFS by the Corps for PG&E Bay Area O&M Program (March 2023 Supplemental Biological Assessment), and the Corps clarified that their request for formal consultation included all of the RGP's proposed activities in tidal waters and freshwater streams in the Bay Area. The Corps also requested on April 4, 2023, NMFS concurrence with the Corps' finding that the O&M Program would not adversely affect threatened California Coastal Chinook salmon, endangered Central California Coast coho salmon, threatened South-Central California Coast steelhead, and their designated critical habitat.

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

1.3. Proposed Federal Action

Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies (see 50 CFR 402.02). Under the MSA, "Federal action" means any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken by a Federal agency (see 50 CFR 600.910).

The Corps proposes to authorize PG&E to conduct routine O&M activities on natural gas and electric transmission distribution infrastructure within wetlands and non-wetland waters of the U.S. within the nine-county San Francisco Bay Area.[2] The Corps would issue the RGP pursuant

[2] The nine Bay Area counties consist of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties.

to Section 404 of the Clean Water Act of 1972, as amended, 33 U.S.C. § 1344 *et seq*. and Section 10 of the Rivers and Harbors Act of 1899, as amended, 33 U.S.C. § 403 *et seq*. The RGP would provide authorization for five (5) years and may be renewed for a total duration of up to 10 years.

PG&E's O&M Program includes activities in terrestrial areas, tidal waters, and freshwater streams. Electrical infrastructure O&M activities will be performed in terrestrial areas and tidal waters (see Section 1.3.2). Natural gas line system O&M activities will be performed in terrestrial areas, tidal waters, and freshwater streams (see Section 1.3.3). Access road maintenance will be performed in terrestrial areas and freshwater streams (see Section 1.3.4). As described in Section 2 of this opinion, eight listed species of anadromous fish may be affected by PG&E's O&M Program. Table 1 provides a summary of listed fish species affected by PG&E O&M activities. Figure 1 presents a map of the Bay Area and overview of PG&E's O&M Program facilities associated with electrical towers and natural gas lines.

Table 1. Categories of O&M Activities and Affected ESA-Listed Fish

PG&E O&M Activity	Area Work Conducted	ESA-Listed Fish Species Present
Electrical Transmission Tower Repair and Replacements	Estuarine	Central California Coast Steelhead
		California Central Valley Steelhead
		Sacramento River Winter-run Chinook
		Central Valley Spring-Run Chinook
		Southern DPS Green Sturgeon
	Terrestrial	n/a
Natural Gas System Infrastructure Repair and Replacement	Estuarine	Central California Coast Steelhead
		California Central Valley Steelhead
		Sacramento River Winter-run Chinook
		Central Valley Spring-Run Chinook
		Southern DPS Green Sturgeon
	Stream Crossings	Central California Coast Steelhead
		South-Central California Coast Steelhead
		California Coastal Chinook
		Central California Coast Coho
	Terrestrial	n/a
Access Road Maintenance	Stream Crossings	Central California Coast Steelhead
		South-Central California Coast Steelhead
		California Coastal Chinook
		Central California Coast Coho
	Terrestrial	n/a

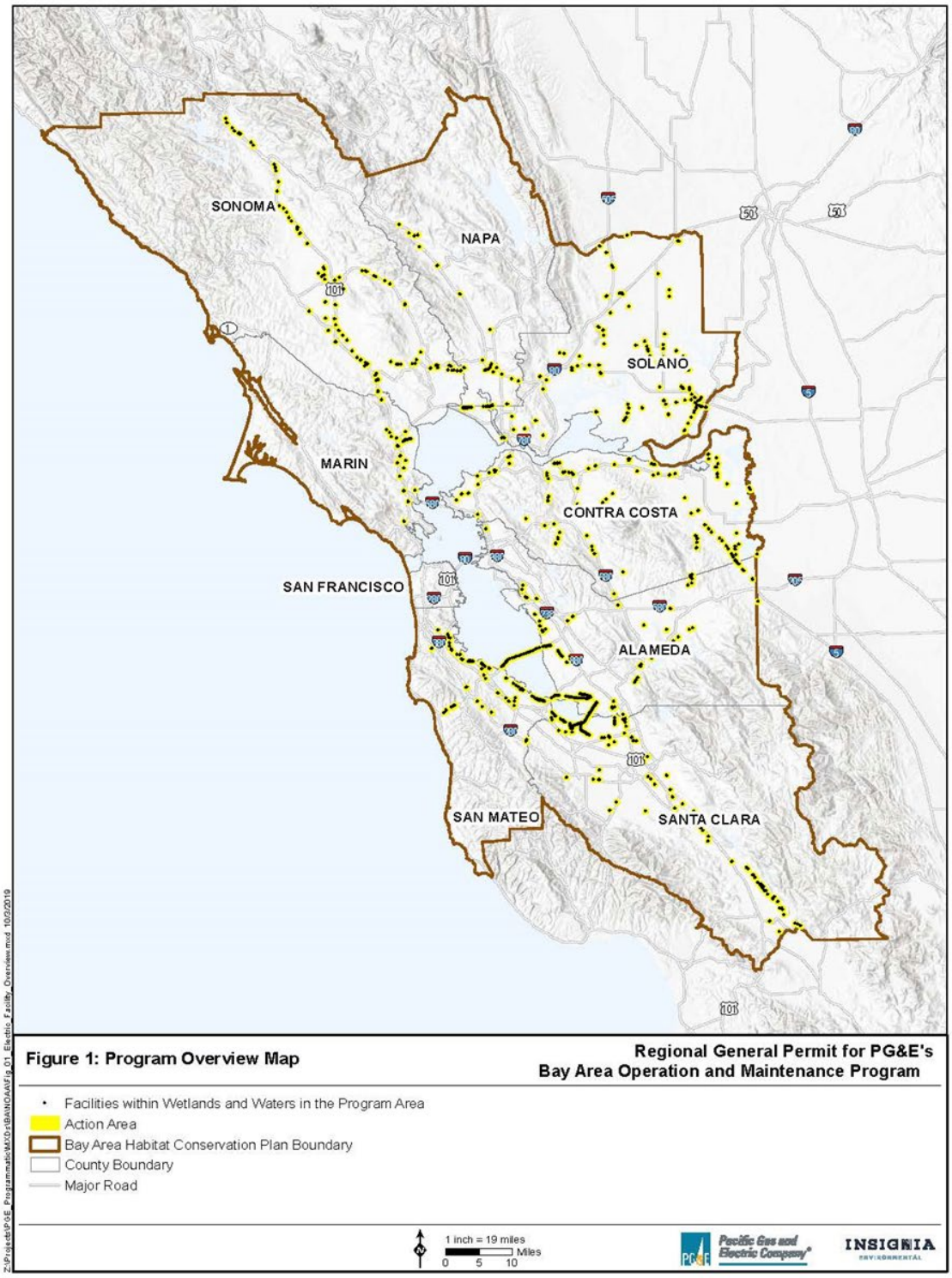

Figure 1. Action Area and Overview of PG&E Bay Area O&M Program Facilities (Source: PG&E Bay Operations September 2022 Biological Assessment)

1.3.1. RGP Implementation Procedures

The RGP implementation process is described in Section 4 of the March 2023 Supplemental Biological Assessment. PG&E will prepare and submit to the Corps project-specific Pre-Construction Notification packages for each proposed O&M Program activity conducted under the RGP. The Pre-Construction Notification must include, among other things, a complete project description, location, construction timing, avoidance/minimization measures, and mitigation actions. The Corps will review each Pre-Construction Notification to confirm eligibility under the RGP and PG&E may not proceed until the Corps provides written approval.

For those activities that may affect NMFS listed fish and/or critical habitat, the Corps or PG&E will provide copies of Pre-Construction Notification packages to NMFS for review. The Corps with input from NMFS will confirm that all Program limits, avoidance/minimization measures, and mitigation requirements developed for this programmatic consultation and required by the RGP are included. For proposed O&M Program actions that do not meet all the requirements of the RGP or this programmatic consultation, the Corps would initiate and complete individual ESA/EFH consultations with NMFS prior to authorizing these activities.

1.3.2. Electrical Infrastructure O&M Activities

PG&E proposes routine maintenance on electrical infrastructure in the Bay Area to maintain safety and operability. The electrical transmission system in the Bay Area consists of approximately 4,430 miles of transmission lines. Bulk transmission lines (230 kV and 500 kV) are supported on steel-lattice towers or steel poles. Power lines with a 60 kV, 70 kV, or 115 kV capacity are most often supported by wood poles, but steel poles, tubular steel poles, and lattice towers are also used in certain areas. The distribution system includes primary and secondary distribution lines that deliver electricity and distribution transformers that reduce voltage from distribution to utilization (i.e., residential or commercial) levels. Primary distribution lines carry three-phase AC power in the 2–50 kV range to street rail and bus systems as well as to industrial and commercial customers. Secondary distribution lines serve most residential customers with 120-/240-volt, single-phase, three-wire service, which provides electrical power for lighting and most appliances.

PG&E conducts patrols of its lines and associated facilities annually or on more frequent basis. Inspections of electrical tower footings and poles are performed to verify stability, structural integrity, and equipment condition (e.g., fuses, breakers, relays, cutouts, switches, transformers, paint). Footings and poles are accessed from existing roads or may require off-road travel, either in vehicles or on foot. Tower replacement or repair typically involves tower extensions or strengthening the foundations or superstructures of towers. Superstructures typically are strengthened by replacement, modification, or the addition of pieces of steel lattice, as determined by engineering analysis specific to each tower. To strengthen tower foundations, concrete from the existing footings is broken away to expose the steel reinforcements. A new replacement concrete footing, called a grade beam, is poured between reinforcements.

The majority of electrical infrastructure O&M activities will be conducted in terrestrial areas. No electrical infrastructure is located in freshwater streams; thus, no electrical tower or pole repair/replacement activities will be conducted in freshwater streams. Some electrical

infrastructure work will be performed by the O&M Program in tidal wetland and estuarine waters in Suisun Bay, Grizzly Bay, San Pablo Bay, and San Francisco Bay, collectively referred to as the San Francisco Bay in this opinion. Table 2 provides a summary of the proposed electrical tower repair and boardwalk activities in tidal areas that may affect listed fish and/or designated critical habitat, and includes the typical equipment used, activity duration, anticipated annual frequency, and average project footprint in fish habitat.

For the purposes of this consultation PG&E has categorized the proposed electrical infrastructure O&M activities in tidal areas as "high" or "low" impact (Table 3). Activities that are defined as high include pile driving or cofferdam installation, and may result in adverse impacts to listed fish species, critical habitat, or EFH. These activities require additional avoidance, minimization or mitigation measures (see Section 1.3.5 of this opinion). All high impact activities would be conducted during a limited operating period (LOP) between June 1 and November 30. Low impact activities would also be conducted between June 1 and November 30, but low impact activities may extend work until January 15, provided that these activities are initiated prior to November 30 of the previous year.

Table 2. Summary of Activities in Tidal Waters

Activity	Equipment	Duration of Each Project	Number in Tidal Habitat	Frequency	Average Footprint in Habitat
Tower Repair and Replacement	Barge, helicopter, rubber mats, metal sheet piles, plywood, concrete, vibratory hammer, impact hammer, and piles	7 to 35 days	121 facilities	17 towers per year	500 square feet
Boardwalk Repair and Replacement	Boat, barge, helicopter, generator and handheld equipment (including drills, chain saws, and circular saws)	60 days	50 miles	15 sections of various lengths per year	variable

Table 3. Activity Type and Impact Level in Tidal Waters

Activity	Impact Level
Tower Repair and Replacement without Pile Driving or Cofferdam Installation	Low
Tower Repair and Replacement with Pile Driving or Cofferdam Installation	High
Boardwalk Repair or Replacement	Low

1.3.2.1 Tower Replacement and Repair

Tower replacement and repair work includes work at the tower site and access to the construction tower site. Replacement refers to the removal of an existing tower and replacement

with a new tower. Tower repair includes the cleaning and repair of concrete tower caps, installation of fiberglass casings, and tower painting. PG&E may temporarily place a rubber mat at the base of each footing as a work area during O&M activities.

Access to towers may occur from existing boardwalks, a temporary section of boardwalk, or crews may utilize a barge as a work area. A helicopter or barge may be used to place construction materials on the boardwalk or barge, and then materials would be moved to the work site by hand. Most minor tower repairs would be conducted from existing boardwalks. A barge with a crane or helicopter would be used to repair or replace the upper portion of the tower, in areas where there are no existing boardwalks, and/or where construction of a temporary boardwalk is not feasible. Depending on the local conditions, the work barges may rest on the bottom of the bay at low tide.

Old tower footings may be abandoned in place or removed in association with tower foundation repairs and replacements (see Section 1.3.2.2). Footing removal would be assessed on a case-by-case basis depending on the impact of removing the footing, or whether the remaining footing would be a hazard to navigation. Cofferdams would be installed to conduct footing removals in tidal waters (see Section 1.3.2.6 of this opinion for additional information regarding cofferdams). Degraded wooden pilings would be removed by being cut at mudline level at low tide.

1.3.2.2 Tower Foundation Repair or Replacement

Tower foundation repair or replacement work in subtidal and intertidal habitats would generally be performed with cofferdams. Cofferdams would be installed during low tide around a tower footing or around the entire tower to isolate the work area from the waters of San Francisco Bay (see Section 1.3.2.6 of this opinion for additional information regarding cofferdams). The cofferdam would keep the enclosed work area dry and minimizes the mobilization of sediment during construction activities.

To strengthen tower foundations, some concrete from the existing footings is removed to expose the steel (rebar) reinforcements. New pins are inserted, a new rebar cage is installed, and concrete forms are constructed. Concrete will be mixed off site and delivered to work sites via helicopter or barge. A form is constructed around the footing to hold the concrete during curing. The concrete is then poured, allowed to cure, and the form is removed. In some instances, grade beams, which hold pile caps together and strengthen tower foundations, are installed between adjacent foundations. This involves installing forms, pouring concrete, and removing the forms. Once the repair is complete, the cofferdam is removed by excavating around the outside and hoisting it from the workspace.

In instances where a complete replacement or new foundations are required, piles are first installed adjacent to the existing foundation (see Section 1.3.2.7 of this opinion for additional information regarding pile driving). Once piles are installed, a new tower foundation is created on the piles. When all replacement work is complete, the cofferdams are removed as described above.

A crew of six to 10 personnel is typically required for tower foundation repair or replacement, and work would occur over a period of 7 to 35 days to complete each tower. Access may occur

on existing roads where available. In-water access occurs through the use of boats and barges for towers within San Francisco Bay and tributaries/tidal sloughs that are large enough for barges to access.

1.3.2.3 Boardwalk Replacement or Repair

PG&E has more than 50 miles of boardwalks that service their electrical transmission facilities in the vegetated marshes, mudflats, and open waters around the San Francisco Bay. The boardwalks typically extend from levees and provide access across marshes and salt ponds to electrical tower footings. Support equipment for replacement and repair of boardwalks include, but is not limited to, boats, barges, and helicopters. A 100-foot by 200-foot staging yard located on land is often also used to store materials. All boardwalk replacement and repair activities are completed manually and require the use of generators and handheld equipment, including, but not limited to drills, chain saws, and circular saws. A crew of three to five personnel conducts the repair or replacement activities and this work typically takes up to 60 days to complete. Crews typically work from existing installed sections of boardwalks, which minimizes the need for access below and around the boardwalk. However, in some instances, work is conducted from barges and/or from the mudflat (*i.e.,* unvegetated sediment) during low tide.

Based on the muddy, soft substrate that is commonly encountered during boardwalk replacement and repair activities, replacement pilings are typically pushed into the mud by using a steel bar for leverage. This method does not require hammering or striking that will result in vibratory or noise disturbance to aquatic species. Occasionally, small pilings may be hammered into place by hand using sledgehammers or similar tools when substrates and sediments require it. Piling installation via hammer or sledgehammer generally requires five to 10 strikes to install a single piling. Each 4-inch by 4-inch piling is made of plastic lumber. Degraded pilings that have been replaced will be removed as close to the mudline as possible by being cut at mudline level during low tide.

Replacement planking is transported along the boardwalk on special hand-dollies. Planking is then slid into place, drilled, and bolted. If the existing section of boardwalk is substantially degraded, crews perform the work within an approximately 10-foot radius around the boardwalk section being replaced. Handrails are then installed (or replaced), which are wood planks that are connected to the boardwalk with support beams.

1.3.2.4 Pole Reinforcement and Replacement

Proposed pole reinforcement methods include attaching trusses to existing poles to provide additional support or the use of a polyvinyl chloride product to reinforce deteriorating wood poles. The most common method to restore ground-level strength to utility poles involves the installation of a single (or in some cases, a double) steel truss. The reinforced pole remains in place next to the installed truss. Composite fabric sheets may also be used for reinforcement of poles. Sheets are wrapped around the pole in layers and a resin material is applied to each layer. PG&E determines the type of reinforcement method after reviewing the results of an inspected line segment. This may require the installation of guy wires and anchors, by line truck auger, which could consist of a screw or a concrete structure. The work is generally performed by a crew of two to five personnel and takes 1 to 2 days to complete.

Pole replacement involves framing the new pole (i.e., crossarms, pins, insulators, grounds, bonding, markers, and any equipment are installed) on the ground adjacent to the existing pole prior to setting the replacement pole in the ground. To replace a pole, the line is typically de-energized. A line truck auger is used to drill a hole, the new pole is placed into the new hole, the void is backfilled and compacted, and the conductors are moved from the old pole to the new pole. The old pole is typically removed, and the old pole site is backfilled with the augured soil. Pole and equipment replacement and repair would require an approximately 10-foot-long by 7-foot-wide work area. The work is generally performed by a crew of four to five personnel and is completed in one day for a distribution pole and up to three days for a transmission pole. Pole replacements conducted by the O&M Program will not be performed in tidal waters or freshwater streams.

1.3.2.5 Line Reconductoring

Line reconductoring involves the replacement of conductors (i.e., wires) once the wires begin to show wear or cannot handle the transmission load or if increased capacity is required. Work crews install replacement conductors by temporarily splicing them to the ends of the existing conductors and pulling them through travelers (i.e., pulleys) attached to the arms of the towers or pole cross-arms. Conductor replacement is performed with boom trucks, winches, and in some cases, a helicopter may be used.

Reconductoring typically is done in 2 to 3-mile sections with the use of temporary pull and tension sites (*i.e.*, pull sites). Several pieces of equipment are used at the pull sites, including tensioners (*i.e.*, rope trucks) to feed out the new conductor and adjust tension, conductor reels to receive the existing conductor as it is removed, and reels of new conductors. This work is generally conducted by a crew of three to eight personnel and potentially one helicopter crew over a period of 1 to 2 months. Although PG&E avoids locating pull sites above water, the geometry of the alignment, pole/tower placement, or topography may require that some pull sites are located on the water. On-water pull sites will be located on a work barge. Aside from utilizing a work barge, no in-water work is associated with line reconductoring activities.

1.3.2.6 Cofferdam Construction in Tidal Waters

As discussed above, cofferdams may be installed to perform tower repairs/replacements in tidal areas. Cofferdams would be constructed of 1.125-inch (approximately) plywood and support beams, or constructed using metal sheet piles. Plywood cofferdams would be installed by first clearing the mud, by hand, from the base of the footing and the plywood is pushed down to 3-foot depth (approximately). Metal sheet pile cofferdams would installed using a vibratory hammer operated from a barge. Mud and sediments removed during construction would be reused on site, or bagged and taken to a landfill. Cofferdams would be installed and closed during low tide. Any water in the cofferdam would be pumped directly onto the adjacent land or into the adjacent water. Avoidance and minimization measures and best management practices for cofferdam installation and dewatering are provided in Section 1.3.5 below.

1.3.2.7 Pile Installation

As discussed above, installation of piles may be required for tower repairs and replacements. Pile types include wood, steel, and concrete piles. Concrete piles would be cast in place using a hollow steel pile as the casing or form. Installations would occur by helical pile driving, vibratory hammer pile driving, and impact hammer pile driving. Helical pile driving is a relatively new method of pile installation where large piles are screwed into the soil instead of being driven with a hammer. The type of pile installation utilized at each site will be determined by the site characteristics (e.g., soil or substrate type) and/or the availability of pile type. Avoidance and minimization measures for pile driving include work windows, hammer cushions, and bubble curtains (see Section 1.3.5 below).

The majority of the pile-driving activities required for tower repair/replacements and foundation repairs/replacements will occur within muddy, fine materials, and soft habitat that range from clay (very fine) to silt to sand (relatively course). Additionally, approximately 92% of the tower foundations where pile driving will occur are located in water depths at or above mean lower low water (MLLW); approximately 7% are located in water depths between 0 and -15 feet MLLW; and less than 1% is located in water depths below -15 feet MLLW. A barge mounted vibratory or impact hammer, or a combination of the two, would be used to drive the piles. A helical pile driver or impact hammer may be utilized to install piles to their final depth. Piles would range from 16 to 72 inches in diameter. When an impact hammer is used, up to 2,000 strikes may occur per day.

When 24-inch diameter piles or smaller are used to repair foundations at a single tower, approximately 16 piles are installed and pile driving would last between 16 and 24 days. When 60-inch diameter piles are used to repair foundations at a single tower, four piles are installed and pile driving would typically take between 6 and 15 days. Installation of 72-inch piles would be similar to 60-inch diameter piles.

1.3.3. Natural Gas System O&M Activities

PG&E acquires natural gas in open markets and moves it (by means of compression) through a series of compressor stations prior to use or storage. Gas is distributed to individual residential and business customers via smaller, lower-pressure distribution pipelines, transitioning from high-pressure lines to smaller, low-pressure lines via pressure regulators or gas pressure-limiting stations. In the Bay Area, PG&E owns and operates a compressor station and 1,820 miles of transmission pipelines, which convey natural gas to 19,350 miles of distribution lines.

Proposed PG&E natural gas line O&M activities will primarily occur in terrestrial areas; although gas line crossings at streams is common and a small number of gas lines are located in tidal wetlands or estuarine waters. Natural gas line O&M activities consist of site-specific erosion measures over pipelines, pipeline recoating, pipeline replacement, valve recoating, and valve replacement. These proposed activity types would occur in terrestrial areas and at waterway crossings throughout the nine counites of San Francisco Bay Area. Table 4 provides a summary of these activities. Table 5 presents the known streams with listed anadromous fish and/or designated critical habitat in the action area with PG&E gas line crossings. Although unlikely, there may be additional gas line locations on streams with listed anadromous fish or

critical habitat that were not identified by PG&E during consultation and are not listed in Table 5. During implementation of the RGP, PG&E's pre-construction notifications for individual O&M activities will identify specific locations and specify whether or not listed anadromous fish or designated critical habitat may be present at work sites.

Table 4. Summary of Natural Gas System O&M Activities in Streams with Listed Anadromous Fish

Activity	Description	Equipment	Duration	Expected Frequency	Footprint in Habitat
Site-Specific Erosion Measures	Protection of gas lines at sites of scour and erosion though placement of biodegradable jute, riprap, and rock	Trucks, backhoe, and excavator	1 to 14 days	2 per year	Up to 500 square feet of permanent impact per project
Pipeline Recoating	Gas lines are recoated with epoxy.	Backhoe, sandblaster, plastic sheeting and tarps, and shot-blasting machine	3 to 5 days	2 per year	No new permanent impacts
Valve Recoating and Replacement	Gas valves are recoated with epoxy or replaced.	Trucks, backhoe, excavator, sandblasting, coating machine, and crane	4 to 6 days for recoating; 28 to 35 days for replacement	1 per year	Up to 200 square feet of permanent impact per project
Pipeline Replacement	Excavation of trench and pipe segments are replaced.	Truck, bulldozer, excavator, frac tank, sideboom, and welding rig	28 to 168 days	2 per year	Up to 2,500 square feet of permanent impact per project

Table 5. Gas Crossing Streams with Listed Anadromous Fish and Critical Habitat[3]

Gas Crossing Number[4]	Stream Name	Likely to Support Year-Round Flow[5]
14	Norton Slough	
15	West Slough	
16, 17	Russian River	YES
24	Tributary to Windsor Creek	
25, 27	Windsor Creek	
26	Mill Creek	
28	Cañon Creek	
29	Napa River	YES
79	Napa River	
30	Putah Creek	
33, 34, 35	South Fork Putah Creek	
38	Tributary to Santa Rosa Creek	
43, 44, 52, 53, 54	Santa Rosa Creek	
45, 46, 48	Tributary to Santa Rosa Creek	
73, 75, 78	Laguna de Santa Rosa	
99	Lindsey Slough	
112	Schell Creek	
113	Huichica Creek	
114	Unnamed Stream	
115	Unnamed Stream	
116, 117, 118, 119	Suscol Creek	
131	Adobe Creek	
132	Green Valley Creek	
135	Cordelia Slough	YES

[3] Additional gas line crossing locations with listed anadromous salmonids and/or designated critical habitat in the Bay Area O&M Program action area (see Figure 1) may be identified during implementation of the RGP.

[4] Reference number from March 2023 Supplemental Biological Assessment. Each reference number refers to a separate gas line crossing.

[5] NOAABA-AMM-13 limits gas line O&M activities in streams with listed anadromous fish and/or designated critical habitat to periods when channels are naturally dry; O&M activities will not be performed in stream channels at these locations if streamflow is present.

Gas Crossing Number[4]	Stream Name	Likely to Support Year-Round Flow[5]
146	Schultz Slough	
149, 150	San Antonio Creek	
183	Sacramento River	YES
185, 186	Grizzly Island Tidal Slough	YES
197	Montezuma Slough	YES
203, 206	Novato Creek	
218, 223	Miller Creek	
226, 227	Taylor Slough - Jersey Island	YES
228	Gallinas Creek	
229, 230	Dutch Slough - Jersey Island	YES
238	Pinole Creek	
239	Pacheco Creek	YES
240	Arroyo del Hambre	
247	Alhambra Creek	
251	Rock Slough	YES
256, 257	Old River	YES
258, 259	Wildcat Creek	
261, 262	Alhambra Creek	
265, 266	Corte Madera Creek	
269, 270	Werner Dredger Cut	YES
338	Arroyo Las Positas	
350	Arroyo Valle	
352	Colma Creek	
360, 363, 364	Vallecitos Creek	
365	Alameda Creek	YES
371, 372, 376, 377	San Mateo Creek	YES
384, 385, 386	Tidal Slough Tributary to Lower Coyote Creek	YES
394, 395, 396,	Apanolio Creek	
387, 397, 399	Pilarcitos Creek	
402, 403	San Francisquito Creek	
404, 405, 415, 416	Coyote Creek	YES

Gas Crossing Number[4]	Stream Name	Likely to Support Year-Round Flow[5]
427, 428, 432, 437, 438, 443, 451	Coyote Creek	
413	Mountain View Slough	YES
414	Stevens Creek	YES
417, 419, 424	Guadalupe River	YES
445	Guadalupe River	
422, 423	Los Trancos Creek	
426	Upper Penitencia Creek	
441	Los Gatos Creek	

1.3.3.1 Site-Specific Erosion Measures at Gas Lines

In locations where scour and erosion within a waterway has exposed a gas pipeline, PG&E proposes to construct site-specific solutions to the erosion problem. Site-specific solutions would consist of placement of biodegradable jute netting, riprap, and rock fill over the exposed portions of the pipeline. These erosion solutions are designed to protect the exposed pipeline and prevent further erosion from occurring. The extent of the erosion solution will typically not be longer than 100 feet or wider than 50 feet on any stream in the program area. Installation will typically begin with preparing the site for installation of the erosion solution. This may involve clearing vegetation and minor recontouring in the area of existing erosion. Once prepared, the erosion solution will be delivered to the site on a truck and placed in the prepared area. The erosion solution will then be installed according to the manufacturer's specifications. Erosion solutions may require geotechnical investigations to design and install.

For scour and erosion solution activities in waterways with listed anadromous fish and/or designated critical habitat (see Table 5), PG&E proposes measures to ensure activities do not degrade fish habitat, impair natural channel functions, or impede fish passage. Specifically, no hardscape will be installed within the streambed or banks at any project sites with listed anadromous fish and/or designated critical habitat. In streams with listed anadromous fish, PG&E will use non-hardscape solutions such as biodegradable jute netting, straw, hydroseeding, waddles, and native plants. In addition, site-specific erosion protection structures will not span more than 20 percent of the active channel width and will not exceed 500 square feet per site. Site-specific erosion measures will be designed to not constrict flow in the channel and not increase water velocities in the channel. Installation of scour and erosion protection will only be conducted when work sites are naturally dry; no dewatering or cofferdams will be utilized for this activity. If work activities impact riparian vegetation, sites will be revegetated with native plant species in a manner consistent with maintaining safety at PG&E's infrastructure. A crew of two to eight personnel is usually required over a period of up to 14 days. PG&E expects to conduct two erosion protection projects per year in waterways with listed anadromous fish and/or designated critical habitat.

1.3.3.2 Pipeline Recoating

When a natural gas line's costing has deteriorated, PG&E proposes to recoat pipelines with epoxy to protect them from degradation and external corrosion. Once recoating is determined to be required, the pipeline segment is excavated using a backhoe. The surface of the pipe is then prepared for the new coating by running a self-contained grit- or shot-blasting machine over the exposed area. The pipeline continues to operate while a coating machine applies the coating. Upon completion of the recoating, sediment excavated to exposed the pipe will be replaced to cover the pipeline and the surface contoured to return the site to pre-construction conditions.

Recoating of pipelines may be conducted at stream crossings. As with site-specific erosion activities, pipeline recoating at stream crossings with listed anadromous fish/critical habitat (see Table 5) will only be performed when the site is naturally dry. No stream dewatering or cofferdams will be used to dewater work sites for recoating of pipelines. When recoating is completed, the trench will be backfilled with the previously excavated materials and the streambed/banks re-countered to pre-construction conditions. On average, an approximately 20-foot-wide work area is needed for this activity. No new permanent impacts are anticipated with this activity, as all work will be performed within the existing pipeline alignment. If work activities impact riparian vegetation, sites will be revegetated with native plant species in a manner consistent with maintaining safety at PG&E's infrastructure. A crew of approximately four to six personnel conducts this activity. Pipeline recoating typically takes 3 to 5 days to complete at stream crossings. PG&E expects to conduct two pipeline recoating projects per year in waterways with listed anadromous fish and/or designated critical habitat.

1.3.3.3 Valve Recoating and Replacement

Proposed O&M Program activities include the recoating and replacement of valves on gas pipelines. Depending on the condition of the valve, PG&E either recoats or replaces the values. Prior to replacing or installing valves, PG&E will isolate portions of the pipeline where work will be performed and excavation may be required to expose the valve. Once the valve has been exposed through excavation, recoating is conducted by sandblasting the valve over tarps, collecting the debris, and recoating the valve with a specialized epoxy that protects against corrosion. The recoating process generally takes 4 to 6 days to complete, and would be conducted by a crew of six to 13 personnel.

Valve replacement involves excavation of soils to access the existing valve and adjacent segment of pipeline, removal of the existing valve (and potentially a segment of the adjacent pipeline), installation of the new valve, and backfill of the excavated area. Valve recoating or replacement typically involves excavating an area 40 feet by 60 feet to access the valves. Each valve replacement typically takes 28 to 35 days to complete, and would be performed with the same equipment as recoating.

PG&E identified only two valves in the O&M Program area that are located within 100 feet of waterways supporting listed anadromous fish and/or critical habitat. If work is required at either of these valves, only one would be worked on per year. Valve recoating or replacement activities would not be performed in wetted areas of waterways with anadromous fish. Excavation of materials to expose valves located near waterways with listed anadromous fish would be

performed without disturbing the stream channel. If work activities impact riparian vegetation, sites will be revegetated with native plant species in a manner consistent with maintaining safety at PG&E's infrastructure.

1.3.3.4 Gas Pressure Limiting Station Construction

PG&E may install new pressure limiting stations on natural gas lines. Human population densities determine the class location of pipeline designations. A change in the class location designation may trigger the installation of a pressure limiting station. Pressure limiting stations lower the pressure of the gas in a line. A typical station encompasses a footprint of approximately 250 feet by 100 feet, including above ground pipe and valve structures, and a small control building surrounded by security fencing. Pressure limiting stations will not be located in tidal waters or freshwater streams.

1.3.3.5 Pipeline Replacement

Proposed O&M Program activities include the replacement of sections of natural gas lines. Some replacements may also include lowering the pipeline. The equipment typically required for pipeline segment replacement includes a truck, bulldozer, excavator, frac tank, forklift, lowboy and trailer, sideboom, water truck, and a welding rig. Pipeline segment replacement begins with clearing and grading the right-of-way, and trenching and excavating the existing pipeline. A new trench is excavated for the new pipeline segment parallel and adjacent to the existing pipeline. PG&E typically places the new section of pipe as close to the abandoned pipeline as possible and modifies any existing easements by expanding the easement width to accommodate the new section of pipeline.

The length of affected pipe varies, depending on the reason for replacement. The minimum length of pipe replaced is typically 40 feet. For longer pipeline segment replacements, a welded and coated pipe is lifted and lowered into the trench by sideboom tractors and excavators. Padded slings are used so the tractors can lower the pipe without damaging the pipe's protective coating. For shorter pipeline replacements, especially sections damaged by third parties or corrosion, replacements are typically within the same alignment. Old pipeline segments may be removed or abandoned in place.

Following the placement of the new pipeline segment and removal of any existing segments, all trenches are then backfilled. Backfilling the trench involves replacing and compacting the excavated subsoil into the trench and re-spreading the stockpiled topsoil, if appropriate, to return the surface to its original grade. Native material excavated from the pipeline trench is used to backfill the trench.

In most cases, pipeline replacements are not located in waters. However, there may be some segments within waters, including waters containing listed anadromous fish and their critical habitat. As described above for erosion measures and pipeline recoating, PG&E proposes to only perform pipeline replacements at stream crossings with listed anadromous fish/critical habitat (see Table 5) when the site is naturally dry. No stream dewatering or cofferdams will be used to dewater work sites for pipeline replacements. When the new pipe segment is installed, the trench will be backfilled with the previously excavated native materials and the streambed/banks re-

countered to pre-construction conditions. If work activities impact riparian vegetation, sites will be revegetated with native plant species in a manner consistent with maintaining safety at PG&E's infrastructure.

The O&M Program also proposes to ensure gas line crossing activities do not create any fish passage impediments for anadromous species. NOAABA-AMM-15 requires PG&E to evaluate all pipeline replacement and abandonment activities at sites with listed anadromous fish and/or critical habitat and confirm that the project design conforms with the most current NMFS guidelines for fish passage at stream crossings.

On average, trenching for pipeline replacement typically requires a 10-foot wide excavation area. A crew of approximately 15 to 20 personnel is required to conduct this activity. Approximately 14 to 28 days are required to complete small pipeline replacements. Although most pipeline replacement actions will occur within the existing pipeline footprint, there may be sites where minor adjustments to the alignment are required.

1.3.4. Road Maintenance for Facility Access

Access to PG&E's electrical infrastructure and gas line facilities requires routine maintenance of roads. Routine road maintenance activities for the O&M Program will include blading to smooth over washouts, eroded areas, and washboard surfaces as needed. Access road maintenance could also include cleaning ditches, moving and establishing berms, clearing and making functional drain inlets, clearing and establishing water bars, and cleaning and repairing over-side drains. Road maintenance activities will primarily be conducted in upland areas and outside of waterways with listed anadromous fish. However, the O&M Program may also repair/replace culverts on streams to ensure safe access to and from PG&E electrical infrastructure and natural gas line facilities. The location of these stream crossing activities could occur throughout the nine-county O&M Program area, including sites on streams with listed anadromous fish and/or critical habitat (See Table 5).

At some O&M project sites a temporary bridge may be installed on an existing roadway to cross a channel. Portable, prefabricated bridges will be used and remain in place for the duration of the O&M project, which can range from a few days to 24 weeks. Temporary bridges will be installed over a stream crossing as a clear-span structure (NOAABA-AMM-15). No bridge structural elements will extend into the channel and a crane would be used to place the bridge without disturbing the channel or waters of the stream. No new roads with be constructed in associated with temporary bridges or culvert repairs/replacements.

Construction activities associated with culvert repair/replacement would not occur in flowing waters on streams with listed anadromous salmonids/critical habitat. PG&E proposes to only conduct culvert work at stream crossings when the work sites are naturally dry (NOAABA-AMM-13). No stream dewatering or cofferdams will be used to dewater work sites for road maintenance activities in streams with anadromous fish and/or critical habitat. In addition, PG&E will ensure that all culvert activities at sites with listed anadromous fish and/or critical habitat will be designed to meet the most current NMFS guidelines for fish passage at stream crossings (NOAABA-AMM-15). If work activities impact riparian vegetation, sites will be revegetated with native plant species in a manner consistent with maintaining safety at PG&E's

infrastructure (NOAABA-AMM-16). No more than two culvert repair/replacement or bridge crossing projects will occur per year on streams with listed anadromous fish and/or critical habitat. Each culvert replacement project may permanently affect up to 5,000 square feet of area.

1.3.5. Avoidance and Minimization Measures

PG&E's proposed avoidance and minimization measures for the O&M Program are presented in the September 2022 Biological Assessment, Section 2.1 and Attachment A. Additional and revised avoidance and minimization measures are presented in the March 2023 Supplemental Biological Assessment, Section 4.

Measures presented below are a sub-set of the proposed measures and designed to address water quality, listed fish species, elevated underwater sound levels, and fish habitat. All proposed avoidance and minimization measures are presented in the September 2022 Biological Assessment and the March 2023 Supplemental Biological Assessment.

BA-AMM-03: Annual Reporting. PG&E will prepare and submit an annual report to the U.S. Fish and Wildlife Service (USFWS) and NOAA Fisheries by March 31 for O&M activities conducted during the previous calendar year. The annual report will include a brief description of each project (e.g., project type and location), as well as any listed species observed and designated critical habitat or sensitive habitat in which worked was conducted. In addition, specific detail regarding the status of the project construction (i.e., not constructed, under construction, or completed); date of project implementation and duration of construction; a listing of pile size, type, and installation methods; estimated length of boardwalks repaired or replaced, and materials used; mitigation information; and any underwater noise monitoring will be included in the annual report.

WQ-AMM-01: **Discharge from Construction.** Discharge of the following to surface waters, ground waters, or land will be prohibited:

- unset cement, concrete, grout or damaged concrete spoils;
- water that has contact uncured concrete or cement; or
- concrete related washout.

If concrete washout is necessary at a site, washout containment will be used to prevent any discharge. Wastewater will be delivered to and disposed of at a sanitary wastewater collection system/facility (with authorization from the facility's owner or operator) or a properly licensed disposal or reuse facility.

WQ-AMM-02: Refueling Procedure. Vehicular and equipment refueling within 250 feet from the edge of vernal pools, and 100 feet from the edge of other wetlands, streams, or waterways is prohibited. If refueling must be conducted closer to wetlands, a secondary containment area subject to review by an environmental field specialist and/or biologist will be constructed. Spill prevention and cleanup equipment will be maintained in refueling areas.

BA Attachment A: Activity Specific Erosion and Sediment Control Plan. PG&E will develop and implement an Activity-Specific Erosion and Sediment Control Plan (A-ESCP) for

all construction projects, and good-housekeeping best management practices (BMPs) are implemented throughout the year. PG&E's Good Housekeeping A-ESCP with standard BMPs is presented as Attachment A to the BA.

WQ-AMM-03: In-Water Activities. The duration of in-water activity will be limited to the minimum amount of time necessary to conduct O&M activities

WQ-AMM-04: Staging and Storage Area. Staging and storage areas for equipment, materials, fuels, lubricants, and solvents will be located away from wetlands and waters, as feasible, in areas where spoil or accidental spills cannot be washed into the water feature.

NOAABA-AMM-01: Boat Access and Docking. Every effort will be made to minimize disturbance to subtidal and wetland vegetation. During boat access, boats will be docked to existing facilities or landed in areas that minimize the potential impact to subtidal and wetland vegetation. Barges will be placed on mudflats in such a manner that subtidal and wetland vegetation is not disturbed. Work crews will be trained to avoid vegetated areas, and foot traffic will be confined to existing facilities, mudflats, and established work areas to minimize disturbance to vegetation.

NOAABA-AMM-02: Dewatering in Tidal Waters. All water pumps used during initial dewatering and fish relocation will follow the intake screen criteria identified in NOAA Fisheries' *Juvenile Fish Screen Criteria for Pump Intakes (1996) See https://media.fisheries.noaa.gov/dam-migration/fish_screen_criteria_for_pumped_water_intakes.pdf.* Water remaining in the cofferdam will be pumped directly onto the adjacent land at low tide when feasible, and a qualified biological monitor will be present. If pumping water onto adjacent land is not feasible, water will be pumped into open water or mudflats directly adjacent to the cofferdam. Fish encountered during dewatering will be carefully relocated by a NOAA Fisheries and U.S. Fish and Wildlife Service-approved fisheries biologist to suitable habitat adjacent to work areas, per NOAABA-AMM-03. Dewatering activities will not be conducted within streams that support federally listed fish.

NOAABA-AMM-03: Fish Salvage and Relocation in Isolated Tideland Pools and Cofferdam Dewatering in Tidal Waters. An experienced fisheries biologist will be present to observe cofferdam dewatering activities whenever pumps are operating and monitor work in tidal waters that may hold salmonids in isolated pools. The agency-approved biologist will ensure that fish species do not become trapped against the cofferdam filter and any fish that were not swept out of the work area will be rescued. Efforts will be made to reduce collecting and handling stress, minimize the time that fish are held in buckets, and minimize handling stress during processing and release. Fish collection efforts will be conducted using sweep and block nets and will occur within the cofferdam area until multiple passes have been conducted and substantial depletion or absence of fish has been documented. Rescued fish will be released 100 feet away from the cofferdam, or at another location approved by NOAA Fisheries as soon as possible. Additional fish salvage and relocation procedures include the following:

- No employee or contractor will remove any fish, dead or alive, from the site for personal use. All efforts to reduce the time that live fish are out of the water will be made to

reduce the chances of fish injury or death during the fish rescue. All fish will be promptly returned to the water.

- Listed fish species will be processed first and released as soon as possible. All fish species will be recorded on data sheets, as well as the time and date that each individual was caught; location where the individual was caught; gear type used; water temperature; total number of individuals caught; and any other pertinent observations of the fish.

- After the fish rescue effort is completed, dewatering of the area will continue. The agency-approved biologist and/or fish rescue biologist will provide a worker education program in the event that additional fish may remain within the dewatering area. The biologist will return to the site to rescue additional fish if the workers observe them within the dewatering area.

- If any turtles or snakes are captured during fish rescue, they will be relocated to the fish release site(s).

Following dewatering and relocation of fish, further monitoring by an experienced fisheries biologist will no longer be required for the dewatered area, unless the integrity of the cofferdam seal is compromised and the work area becomes re-watered.

NOAABA-AMM-04: Seasonal Avoidance in Estuary/Bay Waters for Low-Impact Activities. In-water O&M activities that do not include impact hammer use and do not include cofferdam construction are considered "low-impact activities". Low-impact activities within the San Francisco, San Pablo, Suisun, and Grizzly bays will occur during the limited operating period (LOP) (i.e., between June 1 and November 30) to the maximum extent possible in order to avoid Chinook salmon and steelhead migration.

If necessary, in-water O&M activities that do not involve impact pile driving or cofferdam installation will be allowed to occur between June 1 and January 15, provided the activities are initiated prior to November 30. No new O&M activities will be initiated outside of the LOP, and PG&E will finish the activity as soon as logistically possible based on site-specific construction conditions. PG&E will provide compensatory mitigation at an increased ratio for permanent impacts from O&M activities conducted after November 30. (see Section 6 -Compensatory Mitigation in the Project's September 2022 Biological Assessment).

Pole reinforcement and repair above mean high water, as well as tower and/or boardwalk repair and replacement above mean high water, are not subject to this LOP, as PG&E expects potential effects to federally listed fish species will be minimal or will not occur.

NOAABA-AMM-05: Seasonal Avoidance in Estuary/Bay Waters for High-Impact Activities. In-water O&M activities that include impact hammer use and/or cofferdam construction are considered "high-impact activities". High-impact activities within the San Francisco, San Pablo, Suisun, and Grizzly bays will be planned and scheduled to occur between June 1 and November 30. No impact pile driving will be initiated if it cannot reasonably be completed by November 30. If unforeseen circumstances prevent the completion of pile driving

by November 30, PG&E will request an extension from the Corps on a case-by-case basis to complete the pile driving that has already been initiated.

Pole reinforcement and repair above mean high water, as well as boardwalk repair and replacement, are not subject to this LOP, as PG&E expects potential effects to federally listed fish species will be minimal or will not occur.

NOAABA-AMM-06: Soft Start. Prolonged, soft-start procedures will be implemented when impact pile driving is required for piles greater than 20 inches in diameter in waters that provide habitat for federally listed anadromous fish species. Soft-starts will include pile driving at 40- to 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.

NOAABA-AMM-07: Eelgrass Bed Avoidance. PG&E will avoid all eelgrass (*Zostera spp*.) beds. If any O&M activities must occur within eelgrass beds. PG&E will comply with NOAA Fisheries' California Eelgrass Mitigation Policy and Implementing Guidelines (NOAA Fisheries 2014a), including pre- and post-construction surveys to assess impacts to eelgrass.

NOAABA-AMM-08: Installation of Piles. PG&E will prioritize using a vibratory hammer to install piles, but when an impact hammer is necessary, only one hammer will be used at a time with no more than 2,000 strikes per day on piles within an individual work area. PG&E will also utilize sound attenuation devices during pile-driving (e.g., hammer cushions, bubble curtains, dewatered cofferdams, dewatered isolation casings, etc.). Air bubble curtains would be utilized for impact driving of piles larger than 12 inches in diameter unless the work site is dewatered by a cofferdam. In instances when impact driving is limited to periods of low tide and water depths are less than 4 inches for the entire duration of the pile driving, air bubble curtains are not required. In addition, pile-driving activities that require multiple days at the same location will occur at least 12 hours apart to avoid impacts to federally listed fish species.

NOAABA-AMM-09: Installation of Cofferdams. PG&E will prioritize using a vibratory hammer to install sheet pile cofferdams, but when an impact hammer is necessary, only one hammer will be used at a time with no more than 2,000 strikes per day on piles within an individual work area. PG&E will also utilize sound attenuation devices during pile-driving (e.g., hammer cushions, bubble curtains, dewatered cofferdams, dewatered isolation casings, etc.). In addition, pile-driving activities that require multiple days at the same location will occur at least 12 hours apart to avoid impacts to federally listed fish species. Cofferdams will be installed and closed during low tide.

NOAABA-AMM-10: Hydroacoustic Monitoring. PG&E will conduct hydroacoustic monitoring during the installation of all 72-inch piles when cofferdams are not utilized. PG&E will also conduct hydroacoustic monitoring during the installation of the first 60-inch pile at each discrete tower location when cofferdams are not used. If the sound pressure levels (SPLs) do not exceed 206 decibels (dB) peak and/or the daily accumulated sound exposure level (cSEL) does not exceed 187 dB during the monitoring (see Table 7 in the Project's September 2022 Biological Assessment) of the installation of the first 60-inch pile, PG&E may stop monitoring activities at that tower location. If SPLs or cSEL dB levels exceed limits established in Table 7 of the Project's September 2022 Biological Assessment for 60-inch piles, PG&E will take

additional measures to reduce the sound impacts below established sound impact limits. Monitoring will continue at these locations and will only stop when noise is recorded on a continuing basis (one full day or approximately 2,000 strikes) below the thresholds established in Table 7 of the September 2022 Biological Assessment. PG&E will continue to implement these measures for all remaining 60-inch piles at the locations where they were implemented. Hydroacoustic monitoring will only occur when water depth is 3 feet or greater at mean lower low water to allow for adequate depth for hydrophone placement. PG&E will report the results of the monitoring in their annual report using the NMFS Underwater Noise Monitoring Plan Template.

NOAABA-AMM-11: Removal of Piles. Pile removal will occur using either a vibratory hammer or direct pull method of extraction. A vibratory hammer/extraction must be attempted first unless it presents a greater risk of disturbance to sediments (*i.e.,* contaminants are present). The direct pull method will be utilized if it is more appropriate for the substrate type, pile length, and structural integrity of the piling.

NOAABA-AMM-12: Removal of Cofferdams. Cofferdam removal will occur using either a vibratory hammer or direct pull method of extraction. A vibratory hammer/extraction must be attempted first unless it presents a greater risk of disturbance to sediments. The direct pull method will be utilized if it is more appropriate for the substrate type, pile length, and structural integrity of the piling.

NOAABA-AMM-13: In-Stream Work During Dry Conditions Only. Activities performed in streams known to support or with the potential to support listed fisheries (having suitable habitat and connectivity to known fisheries streams) and streams designated as critical habitat will be conducted during naturally dry conditions. In addition, trenching and pipeline excavation activities will not be conducted within flowing streams that provide federally listed fish habitat.

NOAABA-AMM-14: Hardscape Limitation. No hardscape (i.e., rock, concrete, or other hard structural material) will be installed within the bed or banks of any stream that is known to support listed fish or that has suitable habitat, including designated critical habitat, for listed fish as well as connectivity to known listed fisheries streams. Site-specific erosion protection structures will not span more than 20 percent of the active channel width and will not exceed 500 square feet per site. In no cases will site-specific erosion protection structures compromise or impede fish passage. Site-specific erosion measures will not constrict flow in the channel and not increase water velocities in the channel.

NOAABA-AMM-15: Culvert Repair and/or Replacement, Temporary Bridges, and Pipeline Replacement and/or Abandonment to Accommodate Fish Passage. Existing culverts that are repaired or replaced in streams supporting listed fish or that have suitable habitat to support listed fish and connectivity to known listed fisheries streams, and streams designated as critical habitat must meet standards for fish passage as identified in the current version of NOAA Fisheries' Guidelines for Salmonid Passage at Stream Crossings (See https://www.fisheries.noaa.gov/west-coast/habitat-conservation/west-coast-fish-passage-guidelines). PG&E will also ensure that prefabricated bridges are designed in a manner that avoids impacts to streams that support listed fish. If deemed necessary, PG&E will conduct a channel morphology assessment to ensure these standards can be met prior to execution of the

O&M activity. In addition, the use of rock will be minimized, and no more than 2 culvert repairs or replacement will occur in fish habitat per year.

In the event that a pipeline requires replacement or abandonment in place, the pipeline depth and specifications will be designed to meet the standards for fish passage identified in NOAA Fisheries' Guidelines for Salmonid Passage at Stream Crossings. In addition, culvert repair and replacement, pipeline replacement, and pipeline abandonment activities will not be conducted within flowing streams that provide federally listed fish habitat and designated critical habitat. Work will only be conducted when project site conditions are naturally dry.

1.3.6. Mitigation

PG&E intends to provide compensatory mitigation for future impacts from O&M activities in advance by using an estimate of the projected impact (Table 6) and the following proposed mitigation ratios:

- For activities that are conducted within the LOP and result in permanent impacts, PG&E proposes to mitigate for those impacts at a 3-to-1 ratio.
- For activities that are conducted outside of the LOP, PG&E proposes to mitigate for permanent impacts at a ratio of 4-to-1.

Based on the estimated area of new or expanded tower footings placed in San Francisco Bay, PG&E has calculated compensatory mitigation for impacts to estuarine waters (Table 6). The 4-to-1 ratio was used to calculate the highest projected impact totals to provide a conservative estimate for the purpose of calculating initial compensatory mitigation requirements.

Table 6. Projected Permanent Impacts and Compensatory Mitigation in Tidal Waters

Listed Anadromous Fish Species	Approx. Permanent Impact (acres annually)	Projected Compensatory Mitigation with 4-to-1 Ratio (acres)	
		Annually	5 Years
Central Valley Spring-Run Chinook Salmon	<0.01	0.04	0.2
Sacramento River Winter-Run Chinook Salmon	<0.01	0.04	0.2
Central California Coast Steelhead	0.03	0.12	0.6
California Central Valley Steelhead	<0.01	0.04	0.2
Southern DPS of Green Sturgeon	0.02	0.08	0.4
Total	0.08	0.32	1.6

Based on the projected impacts and mitigation proposed, PG&E proposes to contribute $600,000 in initial funding to one or more fish passage and/or fish habitat improvement projects within the San Francisco Bay, and/or freshwater salmonid migratory corridors within the greater San Francisco Bay Area. Should PG&E exceed its initial projected impact, it will contribute additional funding to habitat improvement projects at $10 per square foot of additional compensatory mitigation required, and no less than 0.1 acre.

If the Corps renews the RGP for an additional 5-year period and PG&E has not fully allocated the projected compensatory mitigation credit[6], the remaining credit will apply to the renewed RGP as an advanced credit. If additional compensatory mitigation associated with a 5-year renewal is needed, PG&E will provide additional funding at $10.00 per square foot.

During the course of the program, PG&E will report actual annual impacts to fish and fish habitat over the life of the RGP. PG&E will provide annual updates to NOAA Fisheries showing actual impact acreages converted to compensatory mitigation required using appropriate ratios as outlined above, including a ledger showing debiting and allocation of credit achieved against projected mitigation.

NMFS 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.

The Corps determined the proposed action is not likely to adversely affect threatened South-Central California Coast steelhead (*O. mykiss*), threatened California Coastal Chinook salmon (*O. tshawystsha*), endangered Central California Coast coho salmon (*O. kisutch*), and their designated critical habitat. Our concurrence is documented in the "Not Likely to Adversely Affect" Determinations section (Section 2.12 below).

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.

[6] PG&E has likely overestimated the amount of mitigation to ensure funding is available to accomplish it. If their actual impacts are less than estimated, PG&E will apply the remaining funds to their impacts in the following five years.

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

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

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.

To conduct this assessment, 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 effects of the Program's actions on the listed species, their anticipated response to these actions, and the environmental consequences of the actions as a whole was formulated from the aforementioned resources, and the following biological assessments:

> PG&E. 2022. National Oceanic and Atmospheric Administration – National Marine Fisheries Service Biological Assessment for the Regional General Permit for Pacific Gas and Electric Company's Bay Area Operation and Maintenance Program. September 2022.

PG&E. 2023. National Oceanic and Atmospheric Administration – National Marine Fisheries Service March 2023 Biological Assessment Supplement. March 2023.

Information taken directly form published, citable documents are referenced in the text and listed at the end of this document. A complete record of this consultation is on file at NMFS North-Central Coast Office in Santa Rosa, California (ARN #151422WCR2021SR00227).

2.2. Rangewide Status of the Species and Critical Habitat

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

This biological opinion analyzes the effect of the proposed PG&E O&M Program activities in the San Francisco Bay on the following Federally-listed species (Distinct Population Segment [DPS] or Evolutionary Significant Unit [ESU]) and designated critical habitats:

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

California Central Valley (CCV) steelhead (*O. mykiss*) DPS
Threatened (71 FR 834; January 5, 2006)
Critical habitat (70 FR 52488; September 2, 2005);

Central Valley (CV) spring-run Chinook salmon (*O. tshawytscha*) ESU
Threatened (70 FR 37160; June 28, 2005)
Critical habitat (70 FR 52488; September 2, 2005);

Sacramento River winter-run Chinook salmon (*O. tshawytscha*) ESU
Endangered (70 FR 37160; June 28, 2005)
Critical habitat (58 FR 33212; June 16, 1993);

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. CCC Steelhead and CCV Steelhead

Steelhead are anadromous forms of *Oncorhynchus mykiss*, spending some time in both freshwater and saltwater. Steelhead are iteroparous, or capable of spawning more than once

before death (Busby *et al.* 1996). Although one-time spawners are the great majority, Shapovalov and Taft (1954) reported that repeat spawners are relatively numerous (17.2 percent) in California streams. Steelhead young usually rear in freshwater for 1 to 3 years before migrating to the ocean as smolts, but rearing periods of up to 7 years have been reported. Migration to the ocean usually occurs in the spring. Steelhead may remain in the ocean for 1 to 5 years (2 to 3 years is most common) before returning to their natal streams to spawn (Busby *et al.* 1996).

Adult steelhead typically migrate from the ocean to freshwater between December and April, peaking in January and February (Fukushima and Lesh 1998). Adults returning to spawn may migrate several miles, hundreds of miles in some watersheds, to reach their natal streams. Although spawning typically occurs between January and May, the specific timing of spawning may vary a month or more among streams within a region, and within streams interannually. Spawning and smolt emigration may continue through June (Busby *et al.* 1996). Female steelhead dig a nest in the stream and then deposit their eggs. After fertilization by the male, the female covers the nest with a layer of gravel. Steelhead do not necessarily die after spawning and may return to the ocean, sometimes repeating their spawning migration one or more years. The embryos incubate within the nest. Hatching time varies from about three weeks to two months depending on water temperature. The young fish emerge from the nest about two to six weeks after hatching.

Steelhead fry rear in edgewater habitats and move gradually into pools and riffles as they grow larger. Cover is an important habitat component for juvenile steelhead, both as a velocity refuge and as a means of avoiding predation (Shirvell 1990, Meehan and Bjornn 1991). Steelhead, however, tend to use riffles and other habitats not strongly associated with cover during summer rearing more than other salmonids. Young steelhead feed on a wide variety of aquatic and terrestrial insects, and emerging fry are sometimes preyed upon by older juveniles. Rearing steelhead juveniles prefer water temperatures of 7.2 to 14.4 degrees Celsius (°C) and have an upper lethal limit of 23.9°C (Barnhart 1986, Bjornn and Reiser 1991). However, they can survive in water up to 27°C with saturated dissolved oxygen conditions and a plentiful food supply. Fluctuating diurnal water temperatures also aid in survivability of salmonids (Busby *et al.* 1996). Juvenile steelhead emigrate episodically from natal streams during fall, winter, and spring high flows, to the ocean to continue rearing to maturity.

The distribution of steelhead in the ocean is not well known. Interannual variations in climate, abundance of key prey items (e.g. squid), and density dependent interactions with other salmonid species are key drivers of steelhead distribution and productivity in the marine environment (Atcheson *et al.* 2012; Atcheson *et al.* 2013). Available information indicates that steelhead originating from central California use a cool, stable, thermal habitat window (ranging between 8-14 degrees Celsius [°C]) in the marine environment characteristic of conditions in northern waters above the 40th parallel to the southern boundary of the Bering Sea (Hayes *et al.* 2012).

2.2.1.1 Status of CCC Steelhead

CCC steelhead was listed as federally threatened in 1997 (62 FR 43937) and the listing was updated in 2006 (71 FR 834). This DPS includes all naturally spawned steelhead from the Russian River in Sonoma County to Aptos Creek in Santa Cruz County as well as the drainages

of San Francisco, Suisun, and San Pablo Bays eastward to Chipps Island at the confluence of the Sacramento and San Joaquin rivers. The DPS also includes two artificial propagation programs, the Don Clausen Fish Hatchery and the Kingfisher Flat Hatchery/Scott Creek (Monterey Bay Salmon and Trout Project) steelhead hatchery programs.

Historically, approximately 70 populations of steelhead existed in the CCC steelhead DPS (Spence *et al.* 2008, Spence *et al.* 2012). Many of these populations (about 37) were independent, or potentially independent, meaning they had a high likelihood of surviving for 100 years absent anthropogenic impacts (Bjorkstedt *et al.* 2005). The remaining populations were dependent upon immigration from nearby CCC steelhead DPS populations to ensure their viability (McElhaney *et al.* 2000, Bjorkstedt *et al.* 2005).

While historical and present data on abundance are limited, CCC steelhead numbers are substantially reduced from historical levels. A total of 94,000 adult steelhead were estimated to spawn in the rivers of this DPS in the mid-1960s, including 50,000 fish in the Russian River, which is considered the largest population within the DPS (Busby *et al.* 1996). Recent estimates for the Russian River are on the order of 7,000 adult fish returning to spawn (NMFS 2016a), however abundance estimates for smaller coastal streams in the DPS indicate low but stable levels with recent estimates for several streams (Lagunitas, Waddell, Scott, San Vicente, Pudding, and Caspar creeks) of individual run sizes of 500 fish or less (62 FR 43937). Some loss of genetic diversity has been documented and attributed to previous among-basin transfers of stock and local hatchery production in interior populations in the Russian River (Bjorkstedt *et al.* 2005). In San Francisco Bay streams, reduced population sizes and fragmented habitat condition has likely also depressed genetic diversity in these populations. Similar losses in genetic diversity in the Napa River may have resulted from out-of-basin and out-of-DPS releases of steelhead in the Napa basin in the 1970s and 1980s. These transfers included fish from the South Fork Eel River, San Lorenzo River, Mad River, Russian River, and the Sacramento River.

The scarcity of information on CCC steelhead abundance continues to make it difficult to assess whether conditions have changed appreciably since the previous status review assessment (Williams *et al*. 2016). The most recent status update concludes that steelhead in the CCC DPS remain "likely to become endangered in the foreseeable future", as new and additional information does not appear to suggest a change in extinction risk (NMFS 2016). NMFS concluded that the CCC steelhead DPS shall remain listed as threatened (81 FR 33468; May 26, 2016).

Recent monitoring efforts indicate steelhead still occur in all diversity strata of the DPS. However, hatchery-origin fish remain more prevalent than natural-origin fish in the Russian River, and an overall downward abundance trend was observed in one of the more robust populations, Scott Creek. Small-scale fish passage improvement and habitat restoration projects have improved habitat conditions locally; however, the DPS still faces threats throughout the region from both legacy habitat degradation and modification, as well as new urban growth, continued water diversions, and dams.

A final recovery plan for CCC steelhead was completed by NMFS in October 2016 (NMFS 2016b). The plan describes key threats, actions needed to achieve recovery, and measurable

criteria by which NMFS will determine when recovery has been reached. Recovery plan actions are primarily designed to restore ecological processes that support healthy steelhead populations, and address the various activities that harm these processes and threaten the species' survival. The recovery plan calls for a range of actions including the restoration of floodplains and channel structure, restoring riparian conditions, improving streamflows, restoring fish passage, protecting and restoring estuarine habitat, among other actions.

2.2.1.2 Status of CCV Steelhead

CCV steelhead was listed as federally threatened in 1998 (63 FR 13347) and the listing was updated in 2006 (71 FR 834). This DPS includes all naturally spawned anadromous *O. mykiss* (steelhead) populations below natural and manmade impassable barriers in the Sacramento and San Joaquin rivers and their tributaries, excluding steelhead from San Francisco and San Pablo Bays and their tributaries. The DPS also includes two artificial propagation programs, the Coleman National Fish Hatchery and Feather River Hatchery steelhead hatchery programs.

CCV steelhead historically were well-distributed throughout the Sacramento and San Joaquin rivers (Busby *et al.* 1996). Although it appears CCV steelhead remain widely distributed in Sacramento River tributaries, the vast majority of historical spawning areas are currently above impassable dams. At present, all CCV steelhead are considered winter-run steelhead (McEwan and Jackson 1996), although there are indications that summer steelhead were present in the Sacramento River system prior to the commencement of large-scale dam construction in the 1940s (IEP 1999). McEwan and Jackson (1996) reported that wild steelhead stocks appear to be mostly confined to upper Sacramento River tributaries such as Antelope, Deer, and Mill creeks and the Yuba River. However, naturally spawning populations are also known to occur in Butte Creek, and the upper Sacramento mainstem, Feather, American, Mokelumne, and Stanislaus rivers (CALFED 2000). It is possible that other small populations of naturally spawning steelhead exist in Central Valley streams, but are undetected due to lack of sufficient monitoring and research programs; increases in fisheries monitoring efforts led to the discovery of steelhead populations in streams such as Auburn Ravine and Dry Creek (IEP 1999).

Small self-sustaining populations of CCV steelhead exist in the Stanislaus, Mokelumne, Calaveras, and other tributaries of the San Joaquin River (McEwan 2001). On the Stanislaus River, steelhead smolts have been captured in rotary screw traps at Caswell State Park and Oakdale each year since 1995 (Demko *et al*. 2000). Incidental catches and observations of steelhead juveniles also have occurred on the Tuolumne and Merced rivers during fall-run Chinook salmon monitoring activities, indicating that steelhead are widespread, if not abundant, throughout accessible streams and rivers in the Central Valley (Good *et al*. 2005).

Steelhead counts at the Red Bluff Diversion Dam (RBDD) declined from an average annual count of 11,187 adults for the ten-year period beginning in 1967, to an average annual count 2,202 adults in the 1990's (McEwan and Jackson 1996). Estimates of the adult steelhead population composition in the Sacramento River (natural origin versus hatchery origin) have also changed over this time period; through most of the 1950's, Hallock *et al*. (1961) estimated that 88 percent of returning adults were of natural origin, and this estimate declined to 10-30 percent in the 1990's (McEwan and Jackson 1996). Furthermore, the California Fish and Wildlife Plan estimated a total run size of about 40,000 adults for the entire Central Valley, including San

Francisco Bay, in the early 1960s (CDFW 1965). In 1991-92, this run was probably less than 10,000 fish based on dam counts, hatchery returns and past spawning surveys (McEwan and Jackson 1996).

The 2016 status review (Williams *et al*. 2016) summarized that little had changed in the status of CCV steelhead since 2011 (Williams *et al.* 2011). While there are some increased returns to hatcheries in the Central Valley, the returns of wild fish and data on the wild population are still lacking. Most natural-origin CCV populations are very small, are not monitored, and may lack the resiliency to persist for protracted periods if subjected to additional stressors, particularly widespread stressors such as climate change. The genetic diversity of CCV steelhead has likely been impacted by low population sizes and high numbers of hatchery fish relative to natural-origin fish. The life-history diversity of the DPS is mostly unknown, as very few studies have been published on traits such as age structure, size at age, or growth rates in CCV steelhead.

In July 2014, NMFS released a final Recovery Plan for CCV steelhead (NMFS 2014). The Recovery Plan outlines actions to restore habitat, access, and improve water quality and quantity conditions in the Sacramento River to promote the recovery of listed salmonids. Key actions for the Recovery Plan include conducting landscape-scale restoration throughout the Delta, incorporating ecosystem restoration into Central Valley flood control plans that includes breaching and setting back levees, and restoring flows throughout the Sacramento and San Joaquin River basins and the Delta.

2.2.2. CV Spring-run and Sacramento River Winter-run Chinook Salmon

Chinook salmon return to freshwater to spawn when they are 3 to 8 years old (Healey 1991). Runs are designated on the basis of adult migration timing; however, distinct runs also differ in the degree of maturation at the time of river entry, thermal regime and flow characteristics of their spawning site, and actual time of spawning (Myers *et al.* 1998). Both winter-run and spring-run Chinook salmon tend to enter freshwater as immature fish, migrate far upriver, and delay spawning for weeks or months. For comparison, fall-run Chinook salmon enter freshwater at an advanced stage of maturity, move rapidly to their spawning areas on the mainstem or lower tributaries of rivers, and spawn within a few days or weeks of freshwater entry (Healey 1991). Adult endangered Sacramento River winter-run Chinook salmon enter San Francisco Bay from November through June (Hallock and Fisher 1985), and delay spawning until spring or early summer. Adult threatened Central Valley spring-run Chinook salmon enter the Sacramento-San Joaquin Delta (Delta) beginning in January and enter natal streams from March to July (Myers *et al.* 1998). Central Valley spring-run Chinook salmon adults hold in freshwater over summer and spawn in the fall. Central Valley spring-run Chinook salmon juveniles typically spend a year or more in freshwater before migrating toward the ocean. Adequate instream flows and cool water temperatures are more critical for the survival of Central Valley spring-run Chinook salmon due to over summering by adults and/or juveniles.

Sacramento River winter-run Chinook salmon spawn primarily from mid-April to mid-August, peaking in May and June, in the Sacramento River reach between Keswick Dam and the RBDD. Central Valley spring-run Chinook salmon typically spawn between September and October depending on water temperatures. Chinook salmon generally spawn in waters with moderate gradient and gravel and cobble substrates. Eggs are deposited within the gravel where

incubation, hatching, and subsequent emergence take place. The upper preferred water temperature for spawning adult Chinook salmon is 13°C (Chambers 1956) to 14 °C (Reiser and Bjornn 1979). The length of time required for eggs to develop and hatch is dependent on water temperature, and quite variable.

Sacramento River winter-run Chinook salmon fry begin to emerge from the gravel in late June to early July and continue through October (Fisher 1994). Juvenile winter-run Chinook salmon spend 4 to 7 months in freshwater prior to migrating to the ocean as smolts. Central Valley spring-run Chinook salmon fry emerge from November to March and spend about 3 to 15 months in freshwater prior to migrating towards the ocean (Kjelson *et al*. 1982). Post-emergent fry seek out shallow, nearshore areas with slow current and good cover, and begin feeding on small terrestrial and aquatic insects and crustaceans. Chinook fry and parr may spend time rearing within riverine and/or estuarine habitats including natal tributaries, the Sacramento River, non-natal tributaries to the Sacramento River, and the Delta.

Within estuarine habitat, juvenile rearing Chinook salmon movements are generally dictated by tidal cycles, following the rising tide into shallow water habitats from the deeper main channels, and returning to the main channels when the tide recedes (Healey 1991; Levings 1982; Levy and Northcote 1982). Juvenile Chinook salmon forage in shallow areas with protective cover, such as intertidal and subtidal mudflats, marshes, channels and sloughs (Dunford 1975; McDonald 1960). As juvenile Chinook salmon increase in length, they tend to school in the surface waters of the main and secondary channels and sloughs, following the tides into shallow water habitats to feed (Allen and Hassler 1986). Kjelson *et al*. (1982) reported that juvenile Chinook salmon demonstrated a diel migration pattern, orienting themselves to nearshore cover and structure during the day, but moving into more open, offshore waters at night. The fish also distributed themselves vertically in relation to ambient light. Juvenile Sacramento River winter-run Chinook salmon migrate to the sea as smolts after only rearing in freshwater for 4 to 7 months, and occur in the Delta from October through early May (CDFW 2000). Most Central Valley spring-run Chinook salmon smolts are present in the Delta from mid-March through mid-May depending on flow conditions (CDFW 1998).

2.2.2.1 Status of Sacramento River Winter-run Chinook Salmon

Sacramento River winter-run Chinook salmon was first listed as a threatened species in 1990 (55 FR 46515). In 1994, NMFS reclassified the ESU as an endangered species due to several factors, including: (1) the continued decline and increased variability of run sizes since its listing as a threatened species in 1989; (2) the expectation of weak returns in coming years as the result of two small year classes (1991 and 1993); and (3) continuing threats to the species (59 FR 440). NMFS issued a final listing determination on June 28, 2005 (70 FR 37160). The Sacramento River winter-run Chinook salmon ESU includes winter-run Chinook salmon spawning naturally in the Sacramento River and its tributaries, as well as two artificial propagation programs: winter-run Chinook salmon from the Livingston Stone National Fish Hatchery and winter-run Chinook in a captive broodstock program maintained at Livingston Stone National Fish Hatchery and the University of California Bodega Marine Laboratory.

The Sacramento River winter-run Chinook salmon ESU has been completely displaced from its historical spawning habitat by the construction of Shasta and Keswick dams. Approximately, 300

miles of tributary spawning habitat in the upper Sacramento River is now inaccessible to the ESU. Most components of the Sacramento River winter-run Chinook salmon life history (e.g., spawning, incubation, freshwater rearing) have been compromised by the habitat blockage in the upper Sacramento River. The only remaining spawning habitat in the upper Sacramento River is between Keswick Dam and RBDD. This habitat is artificially maintained by cool water releases from Shasta and Keswick Dams, and the spatial distribution of spawners in the upper Sacramento River is largely governed by the water year type and the ability of the Central Valley Project to manage water temperatures in this area.

Between the time Shasta Dam was built and the Sacramento River winter-run Chinook salmon were listed in 1990, major impacts to the population occurred from warm water releases from Shasta Dam, juvenile and adult passage constraints at the RBDD, water exports in the southern Delta, and entrainment at a large number of unscreened or poorly-screened water diversions. However, the naturally spawning component of this ESU has exhibited marked improvements in abundance and productivity in the 2000s (CDFW 2008). These increases in abundance are encouraging, relative to the years of critically low abundance of the 1980s and early 1990s; however, returns of several West Coast Chinook salmon and coho salmon stocks were lower than expected in 2007, and stocks remained low through 2009.

A captive broodstock artificial propagation program for Sacramento River winter-run Chinook salmon has operated since the early 1990s as part of recovery actions for this ESU. As many as 150,000 juvenile salmon have been released by this program, but in most cases the number of fish released was in the tens of thousands (Good *et al.* 2005).

According to the 2016 NMFS 5-year status review, the extinction risk of the winter-run Chinook salmon ESU has increased from moderate risk to high risk of extinction since the 2007 and 2010 assessments (NMFS 2016c). Based on the Lindley *et al*. (2007) criteria, the population is currently at high extinction risk. High extinction risk for the population was triggered by the hatchery influence criterion, with a mean of 66 percent hatchery origin spawners from 2016 through 2018. Several listing factors have contributed to the recent decline, including drought, poor ocean conditions, and hatchery influence.

In July 2014, NMFS released a final Recovery Plan for Sacramento River winter-run Chinook salmon (NMFS 2014). The Recovery Plan outlines actions to restore habitat, access, and improve water quality and quantity conditions in the Sacramento River to promote the recovery of listed salmonids.

2.2.2.2 Status of CV Spring-run Chinook Salmon

CV spring-run Chinook salmon was listed as a threatened species in 1999 (64 FR 50394) and the listing was updated in 2005 (70 FR 37160). The Central Valley spring-run Chinook ESU includes all naturally spawned populations of spring-run Chinook salmon in the Sacramento River and its tributaries in California, including the Feather River. The artificial propagation program at the Feather River Hatchery is also considered part of the ESU.

Historically, the predominant salmon run in the Central Valley was the spring-run Chinook salmon. Extensive construction of dams throughout the Sacramento-San Joaquin Basin has

reduced the Central Valley spring-run Chinook salmon run to only a small portion of its historical distribution. The Central Valley drainage as a whole is estimated to have supported Central Valley spring-run Chinook salmon runs as large as 600,000 fish between the late 1880s and 1940s (CDFW 1998). The ESU has been reduced to only three naturally-spawning populations that are free of hatchery influence from an estimated 17 historic populations. These three populations (spawning in three tributaries to the Sacramento River - Deer, Mill, and Butte creeks), are in close geographic proximity, increasing the ESU's vulnerability to disease or catastrophic events.

Central Valley spring-run Chinook salmon from the Feather River Hatchery (FRH) were included in the ESU because they are believed by NMFS to be the only population in the ESU that displays early run timing. This early run timing is considered by NMFS to represent an important evolutionary legacy of the spring-run populations that once spawned above Oroville Dam (70 FR 37160). The FRH population is closely related genetically to the natural Feather River population. The FRH's goal is to release five million spring-run Chinook salmon per year. Recent releases have ranged from about one-and-a-half to five million fish, with most releases below five million fish (Good *et al.* 2005).

According to the NMFS 5-year species status review (NMFS 2016d), the status of the CV spring- run Chinook salmon ESU, until 2015, has improved since the 2010 status review. The improved status is due to extensive restoration, and increases in spatial structure with historically extirpated populations (Battle and Clear creeks) trending in the positive direction. However, more recent declines of many of the dependent and independent populations, high pre-spawn and egg mortality during the 2012 to 2016 drought, uncertain juvenile survival during the drought are likely increasing the ESU's extinction risk. Escapement data show a continued overall decline in adult returns from 2014 through 2020 (CDFW 2021).

In July 2014, NMFS released a final Recovery Plan for CV spring-run Chinook salmon (NMFS 2014). The Recovery Plan outlines actions to restore habitat, access, and improve water quality and quantity conditions in the Sacramento River to promote the recovery of listed salmonids. Key actions for the Recovery Plan include conducting landscape-scale restoration throughout the Delta, incorporating ecosystem restoration into Central Valley flood control plans that includes breaching and setting back levees, and restoring flows throughout the Sacramento and San Joaquin River basins and the Delta.

2.2.3. North American Green Sturgeon

The green sturgeon is 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 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: 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 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 is 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 200-meters depth, but spend most of their time in waters between 20–80 meters and temperatures of 9.5–16.0°C (Nelson *et al.* 2010, Huff *et al.* 2011). Subadult and adult green sturgeon move between coastal waters and estuaries (Lindley *et al*. 2008, Lindley *et al.* 2011), 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. 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 analysis, Israel *et al.* (2009) reported that almost all green sturgeon collected in the San Francisco Bay system were Southern DPS. This is corroborated by tagging and tracking studies which found that no green sturgeon tagged in the Klamath or Rogue rivers (i.e., Northern DPS) have yet been detected in San Francisco Bay (Lindley *et al.* 2011). However, green sturgeon inhabiting coastal waters adjacent to San Francisco Bay include Northern DPS green sturgeon.

Adult Southern DPS green sturgeon enter the San Francisco Bay in later winter thought early spring, and migrate upstream to spawn in the Sacramento River watershed from April through early July, with peaks in activity influenced by variations in water low and temperature (Heublein *et al*. 2009, Poytress *et al*. 2015, Miller *et al*. 2020). 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 collected at the State and Federal water export facilities in the southern Delta are generally between 200 mm and 400 mm total length (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. 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). Post-spawn outmigration the San Francisco Bay is variable, with some individuals migrating to the ocean within 2-10 days and others remaining within the estuary for several months after leaving upstream spawning habitat (Heublein *et al*. 2009, Miller *et al*. 2020)

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 on the lower Sacramento River 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 green sturgeon utilize soft substrate in estuaries, presumably feeding on benthic invertebrates. Data from mapping surveys conducted in Willapa Bay, Washington, showed densities of "feeding pits" (depressions in the substrate believed to be formed when green sturgeon feed) were highest over shallow intertidal mud flats, while harder substrates (e.g., sand) had no pits (Moser *et al.* 2017). Within the San Francisco estuary, green sturgeon are encountered by recreational anglers and during sampling by the California Department of Fish and Wildlife (CDFW) in the shallow waters of San Pablo Bay.

2.2.3.1 Status of North American Green Sturgeon

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% 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.

2.2.4. Status of Critical Habitat

In designating critical habitat, NMFS considers, among other things, 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 breeding, reproduction, or rearing offspring; and, generally; and 5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of this species (50 CFR 424.12(b)). In addition to these factors, NMFS also focuses on PBFs within the designated area that are essential to the conservation of the species and that may require special management considerations or protection (81 FR 7214).

2.2.4.1 Status of CCC Steelhead Critical Habitat

Critical habitat was designated for CCC steelhead on September 2, 2005 (70 FR 52488) and includes the following CALWATER Hydrologic Units: Russian River, Bodega, Marin Coastal, San Mateo Coastal, Bay Bridge, Santa Clara, San Pablo, and Big Basin. The PBFs for CCC steelhead critical habitat include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine areas.

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. NMFS has determined that present depressed population conditions are, in part, the result of the following human-induced factors affecting critical habitat: logging; agricultural and mining activities; urbanization; stream channelization; dams; wetland loss; and water withdrawals, including unscreened diversions for irrigation. Impacts of concern include alteration of streambank and channel morphology, alteration of water temperatures, loss of spawning and rearing habitat, fragmentation of habitat, loss of downstream recruitment of spawning gravels and large woody debris, degradation of water quality, removal of riparian vegetation resulting in increased streambank erosion, loss of shade (higher water temperatures) and loss of nutrient inputs (Busby *et al*. 1996, NMFS 2016b). Water development has drastically altered natural hydrologic conditions in many of the streams in the DPS. Alteration of flows results in migration delays, loss of suitable habitat due to dewatering and blockage; stranding of fish from rapid flow fluctuations; entrainment of juveniles into poorly screened or unscreened diversions, and increased water temperatures harmful to salmonids.

2.2.4.2 Status of CCV Steelhead Critical Habitat

Critical habitat was designated for CCV steelhead on September 2, 2005 (70 FR 52488) and includes stream reaches of the Feather, Yuba and American rivers, Big Chico, Butte, Deer, Mill, Battle, Antelope, and Clear creeks, the Sacramento River, as well as portions of the northern Delta. The PBFs for CCV steelhead critical habitat include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, and estuarine areas.

Many of the PBFs of CCV steelhead critical habitat are degraded and provide limited high-quality habitat. Passage to historical spawning and juvenile rearing habitat has been largely reduced due to dam construction throughout the Central Valley. Levee construction has also degraded the freshwater rearing and migration habitat and estuarine areas as riparian vegetation has been removed, reducing habitat complexity and food resources and resulting in many other ecological effects. Additionally, due to reduced access to historical habitat, genetic introgression is occurring because natural-origin fish are interacting with hatchery-origin fish, providing the potential to reduce the long-term fitness and survival of this species.

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

2.2.4.3 Status of Sacramento River Winter-run Chinook Salmon Critical Habitat

Critical habitat was designated for the Sacramento River winter-run Chinook salmon on June 16, 1993 (58 FR 33212). Designated critical habitat for Sacramento River winter-run Chinook salmon includes the Sacramento River from Keswick Dam, Shasta County (River Mile 302) to Chipps Island (River Mile 0), all waters from Chipps Island westward to Carquinez Bridge, all waters of San Pablo Bay, and all water of San Francisco Bay (north of the San Francisco/Oakland Bay Bridge).

PBFs for Sacramento River Winter-run Chinook and their associated essential features include:

1. Access from the Pacific Ocean to appropriate spawning areas in the upper Sacramento River.
2. The availability of clean gravel for spawning substrate.
3. Adequate river flows for successful spawning, incubation of eggs, fry development and emergence, and downstream transport of juveniles.
4. Water temperatures between 6 and 14˚C for successful spawning, egg incubation, and fry development.
5. Habitat areas and adequate prey that are not contaminated.
6. Riparian areas that provide for successful juvenile development and survival.
7. Access downstream so that juveniles can migrate from the spawning grounds to San Francisco Bay and the Pacific Ocean (58 FR 33212).

Winter-run Chinook salmon critical habitat has been degraded from conditions known to support viable salmonid populations. It does not provide the full extent of conservation values necessary for the recovery of the species. In particular, adequate river flows and water temperatures have been impacted by human actions, substantially altering the historical river characteristics in which the Sacramento River winter-run Chinook salmon evolved. Depletion and storage of streamflow behind large dams on the Sacramento River and other tributary streams have drastically altered the natural hydrologic cycles of the Sacramento River and Delta. Alteration of flows results in migration delays, loss of suitable habitat due to dewatering and blockage, stranding of fish from rapid flow fluctuations, entrainment of juveniles into poorly screened or unscreened diversions, and increased water temperatures harmful to salmonids. Other impacts of concern include alteration of stream bank and channel morphology, loss of riparian vegetation, loss of spawning and rearing habitat, fragmentation of habitat, loss of downstream recruitment of spawning gravels, degradation of water quality, and loss of nutrient input.

2.2.4.4 CV Spring-run Chinook Salmon Critical Habitat

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

creeks; and the Sacramento River downstream to the Delta, as well as portions of the northern Delta (70 FR 52488; September 2, 2005). The PBFs for CV spring-run Chinook salmon critical habitat include freshwater spawning sites, freshwater migratory habitat, freshwater rearing sites, and estuarine habitat.

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

2.2.4.5 Status of North American Green Sturgeon Critical Habitat

Critical habitat was designated for the Southern DPS of green sturgeon on October 9, 2009 (74 FR 52300) and includes coastal marine waters within 60 fathoms depth from Monterey Bay, California to Cape Flattery, Washington, including the Strait of Juan de Fuca to its United States boundary. Designated critical habitat also includes the Sacramento River, lower Feather River, lower Yuba River, Sacramento-San Joaquin Delta, Suisun Bay, San Pablo Bay, and San Francisco Bay in California.

PBFs of designated critical habitat in estuarine areas are food resources, water flow, water quality, mitigation corridor, depth, and sediment quality. In freshwater riverine systems, PBFs of green sturgeon critical habitat are food resources, substrate type or size, water flow, water quality, migratory corridor, depth, and sediment quality. In nearshore coastal marine areas, PBFs are migratory corridor, water quality, and food resources.

The current condition of critical habitat for the Southern DPS of green sturgeon is degraded over its historical conditions. It does not provide the full extent of conservation values necessary for the recovery of the species, particularly in the upstream riverine habitat of the Sacramento River. In the Sacramento River, migration corridor and water flow PBFs have been impacted by human actions, substantially altering the historical river characteristics in which the Southern DPS of green sturgeon evolved. In addition, the alterations to the Sacramento-San Joaquin River Delta may have a particularly strong impact on the survival and recruitment of juvenile green sturgeon due to their protracted rearing time in brackish and estuarine waters.

2.2.5. Additional Threats to Listed Species and Critical Habitat

2.2.5.1 Global Climate Change

Another factor affecting the range wide status of CCC steelhead, CCV steelhead, winter-run Chinook salmon, CV spring-run Chinook salmon, Southern DPS green sturgeon, and aquatic habitat at large is climate change. Recent work by the NMFS Science Centers ranked the relative vulnerability of west-coast salmon and steelhead to climate change. In California, listed coho and

Chinook salmon are generally at greater risk (high to very high risk) than listed steelhead (moderate to high risk) (Crozier *et al.* 2019).

Impacts from global climate change are already occurring in California. For example, average annual air temperatures, heat extremes, and sea level increased in California over the last century (Kadir *et al*. 2013). Snowmelt from the Sierra Nevada has declined (Kadir *et al*. 2013). Listed salmon, steelhead and green sturgeon have likely already experienced some detrimental impacts from climate change through lower and more variable stream flows, warmer stream temperatures, and changes in ocean conditions. California experienced well below average precipitation during the 2012-2016 drought, as well as record high surface air temperatures in 2014 and 2015, and record low snowpack in 2015 (Williams *et al*. 2016). Paleoclimate reconstructions suggest the 2012-2016 drought was the most extreme in the past 500 to 1000 years (Williams *et al*. 2016 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).

The threat to CCC steelhead, CCV steelhead, winter-run Chinook salmon, CV spring-run Chinook salmon and green sturgeon from global climate change is expected to increase in the future. Modeling of climate change impacts in California suggests that average summer air temperatures are expected to continue to increase (Lindley *et al.* 2007; Moser *et al*. 2012). 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 and the magnitude and frequency of dry years may increase (Lindley et al. 2007; Schneider 2007; Moser *et al.* 2012). Similarly, wildfires are expected to increase in frequency and magnitude (Westerling *et al.* 2011; 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). 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 juvenile and adult salmonids 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). Some of these changes, including an increased incidence of marine heat waves, are likely already occurring, and are expected to increase (Frolicher, *et al.* 2018). In fall 2014, and again in 2019, a marine heatwave, known as “The Blob”, formed throughout the northeast Pacific Ocean, which greatly affected water temperature and upwelling from the Bering Sea off Alaska, south to the coastline of Mexico. The marine waters in this region of the ocean are utilized by salmonids for foraging as they mature (Beamish 2018). Although the implications of these events on salmonid populations are not fully understood, they are having considerable adverse consequences to the productivity of these ecosystems and presumably contributing to poor marine survival of salmonids.

2.2.5.2 Water Quality

Recently published work has identified stormwater from roadways as causing mortality of adult coho salmon in the wild (Scholz *et al.* 2011) and laboratory settings (McIntyre *et al.* 2018). Subsequent laboratory studies showed this morality also occurred in juvenile coho salmon (Chow *et al.* 2019) as well as to juvenile steelhead and Chinook salmon (Brinkmann *et al*. 2022). These recent publications have identified a degradation product of tires (6PPD-quinone) as the causal factor in this mortality (Tian *et al.* 2022, Brinkmann *et al*. 2022, Tian *et al*. 2020; Peter *et al*. 2018). The parent compound (6PPD) is widely used by multiple tire manufacturers and the tire shreds/dust that produce the degradation product have been found to be ubiquitous where both rural and urban roadways drain into waterways (Feist *et al*. 2018, Sutton *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 this consultation includes all areas that will be directly and indirectly affected by PG&E's routine maintenance activities at electrical facilities, gas line facilities, and access roads within the nine-county San Francisco Bay Area.[7] Figure 1 displays the locations of PG&E facilities in the O&M Program action area. Although O&M Program activities can occur at any of the locations in Figure 1, most PG&E facilities associated with freshwater streams are located in urban or "developed" areas where instream habitat and natural channel function are impaired. In tidal waters and wetlands, PG&E's electrical towers are primarily located adjacent to bridges and in wetland areas along the margin of the Bay.

2.4. Environmental Baseline

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

San Francisco Bay is the largest estuary on the west coast of North American in terms of surface area and it is also one of the most urbanized. The human population within the San Francisco Bay Area is approximately eight million (2020 census). In the past 150 years, the diking and filling of tidal marshes has decreased the surface area of the San Francisco Bay by 37 percent, which has diminished tidal marsh habitat, increased pollutant loadings to the estuary, and degraded shoreline habitat. Most shoreline areas are dominated by docks, shipping wharves,

[7] The nine Bay Area counties consist of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties.

marinas, and miles of rock riprap for erosion protection. Most tributary streams have lost habitat through channelization, riparian vegetation removal, and water development. Dams blocking anadromy are present on most streams and the associated reservoirs are used for water supply, aquifer recharge, and/or recreational activities.

2.4.1. San Francisco Bay Estuary Description

The Bay receives inputs from the Sacramento and San Joaquin rivers, Bay Area tributary streams, stormwater runoff, and wastewater from municipal and industrial sources that vary in volume depending on the location and seasonal weather patterns. The freshwater outflow pattern is seasonal with the highest outflow occurring in the winter and spring. Local watersheds adjacent to the Bay contribute approximately 56 percent of the sediment delivered to the Bay, with the Delta and coastal sources contributing the remaining sediment supply (Barnard *et al.* 2013). Current and wave patterns in the estuarine portion of the action area are largely generated by the tides interacting with the bottom and shoreline configurations.

Central Bay, Suisun Bay, San Pablo Bay, and the South Bay all have shallow areas with mud to sand bottom, and deeper channels with mainly sand bottom. The mean water depth of the Central Bay is approximately 40 feet while the South Bay, San Pablo Bay and Suisun Bay have mean depths of 16 feet or less. Most of the Bay floor is comprised of sand and mud, overlying metamorphic and sedimentary bedrock. Bottom sediments are mud-dominated in shallower, low tidal energy areas. Sand is prevalent in deeper high tidal energy areas, such as the deeper portions of Central Bay and Suisun Bay, particularly within the main tidal channels where large waveforms are present along the Bay floor (Barnard *et al*. 2013). Both wind and tidal currents are strong in many parts of the estuary. The Carquinez Strait and Golden Gate are relatively narrow sections where tidal currents are particularly strong. Wind-driven waves throughout the estuary are particularly common during the summer and these waves re-suspend sediments and increase local turbidity. Salinity varies from freshwater values in Suisun Bay to oceanic values at the Golden Gate.

2.4.2. Bay Area Watersheds Description

Freshwater streams in action area (Table 5) drain to either San Francisco Bay or drain directly to the Pacific Ocean. The watersheds that drain to San Francisco Bay contain highly developed urban areas. Dams in upper watershed areas have been constructed for water development. Lower bayside reaches are typically characterized by hardened channels that have been re-aligned for flood control as they pass through heavily urbanized areas. However, some upper watershed areas remain relatively undeveloped and are protected in regional and State parks.

Over 90% of the annual freshwater that discharges into the San Francisco Bay comes from the Sacramento and San Joaquin rivers that combined, drain the Central Valley. The approximately 66 smaller watersheds that drain into the San Francisco Estuary contribute the remaining 10% of freshwater runoff (Leidy *et al.* 2017). Parallel-trending coastal and interior coastal mountains and hills surrounding the Bay are oriented along a general northwest to southeast axis. The largest watersheds draining to San Francisco Bay are Napa River (426 square miles) and Alameda Creek (700 square miles) (Leidy *et al.* 2017).

The action area also includes portions of the Russian River and the Pajaro River watersheds. The Russian River watershed encompasses approximately 1,500 square miles of forests, agricultural lands, and urban areas within Sonoma and Mendocino counties. About 95% of the watershed is in private ownership. The Russian River is about 110 miles long and flows from its headwaters near Redwood and Potter Valleys to the Pacific Ocean at the town of Jenner on the Sonoma Coast.

The Pajaro River watershed is approximately 1,300 square miles and it includes agricultural lands, natural areas, and urban development in Santa Clara, Santa Cruz, San Benito, and Monterey counties. The Pajaro River watershed's rivers, tributaries, and creeks ultimately drain into Monterey Bay.

The topography of the action area is extremely varied, with elevations ranging from sea level to 4,265 feet atop of Mount Hamilton in the Diablo Range. Overall, the climate of the action area is characterized by dry, mild summers and moist, cool winters. Temperatures are strongly influenced by the San Francisco Bay, the Pacific Ocean, and the various Bay Area mountain ranges, which results in a variety of microclimates. Coastside is generally mountainous and experiences a marine climate, characterized by cool, foggy summers and relatively wet winters. The Bayside features a flatter topography, and is generally warmer and sunnier than coastal areas.

2.4.3. Status of Listed Species and Critical Habitat in the Action Area

2.4.3.1 Status of Listed Anadromous Salmonids in the Estuarine Portion of the Action Area

The San Francisco Bay portion of the action area is used primarily as a migration corridor by listed CCC steelhead, CCV steelhead, CV spring-run Chinook salmon, and Sacramento River winter-run Chinook salmon. Adult salmonids migrate from the Pacific Ocean through the San Francisco Bay as they seek the upstream spawning grounds of their natal streams. Adult CCV steelhead migration through the Bay typically begins in fall and winter (McEwan and Jackson 1996). Adult CCC steelhead typically migrate through San Francisco Bay to their natal streams from December through April. Adult Sacramento River winter-run Chinook migrate through San Francisco Bay between December and May. Adult Central Valley spring-run Chinook salmon enter the Bay from the ocean for their upstream migration between February and April.

Juvenile (smolt) salmonids migrate from their natal streams through San Francisco Bay to the ocean. Emigration timing is highly variable among Sacramento River winter-run Chinook, CV spring-run Chinook, CCC steelhead and CCV steelhead smolts, but peak migrations downstream typically occur through the estuary during the late winter and spring months. To assess juvenile salmonid outmigration behavior and timing, a series of studies were performed from 2006 through 2010 with Central Valley late fall-run Chinook salmon and CCV steelhead smolts. Smolt-sized juveniles originating from Coleman National Fish Hatchery were tagged with acoustic transmitters and released in the Sacramento River to monitor their downstream movement to ocean-entry at the Golden Gate. Results showed that smolts generally transited the Bay rapidly in 2 to 4 days, yet also made repeated upstream movements, coinciding with incoming tidal flows (Hearn *et al*. 2013). Most Chinook and steelhead smolts were detected by

acoustic receivers located over deep, channelized portions of the Bay (Hearn *et al* 2013). Smolts detected at nearshore, shallow sites such as marinas, or up tributaries generally returned to the main channel to finish their migration (Hearn *et al*. 2013).

During the course of their downstream migration, juvenile listed salmon and steelhead may utilize estuarine waters for seasonal rearing, but available information suggests that fish are actively migrating and currently they do not reside for extended periods in San Francisco Bay (Hearn *et al*. 2010). Historically, the tidal marshes of the Bay provided a highly productive estuarine environment for juvenile anadromous salmonids. However, loss of habitat, changes in prey communities, and water-flow alterations and reductions have degraded habitat and likely limit the ability of the Bay to support juvenile rearing. MacFarlane and Norton (2002) found that fall-run Chinook experienced little growth, depleted condition, and no accumulation of lipid energy reserves during the relatively limited time the fish spent transiting the 40-mile length of the estuary. Sandstrom *et al*. (2013) found that CCC steelhead smolts emigrated more rapidly through the Bay than the Napa River and the ocean.

In contrast to demersal fish that are associated with the channel bottom, salmonids are pelagic fish and, as such, primarily occupy the water column and near surface when over deeper waters (Mari-Gold Environmental and Novo Aquatic Sciences 2009). Within the action area, listed salmon and steelhead are thought to typically display a preferential use of the middle and upper water column. Studies by Kjelson *et al*. (1982) in the Sacramento-San Joaquin Delta concluded juvenile Chinook salmon appear to prefer shallow water habitats near the shore and the upper portion of the water column (less than 10 feet deep).

2.4.3.2 Status of Listed Anadromous Salmonids in the Freshwater Portion of the Action Area

Adult listed Central Valley anadromous salmonids (CCV steelhead, CV Spring-run Chinook salmon, and Sacramento River winter-run Chinook salmon) migrate through the estuary and into the Sacramento River to spawn in the upper Sacramento River and its tributaries. Following emergence from redds, fry and juvenile rearing occurs in freshwater reaches in the upper Sacramento River watershed. These spawning and rearing sites in the upper Sacramento River watershed are outside of this project's action area and the O&M Program is not expected affect the spawning and freshwater rearing habitats of listed Central Valley anadromous salmonids.

For CCC steelhead, freshwater streams in the action area support migration, spawning, and rearing. Small populations of CCC steelhead occur in several Bay tributary streams including Arroyo Corte Madera del Presido, Corte Madera Creek, Napa River, Sonoma Creek, Petaluma River, Novato Creek, Pinole Creek, Coyote Creek, Guadalupe River, San Mateo Creek, San Francisquito Creek, and Stevens Creek (NMFS 2016b). North of San Francisco Bay, CCC steelhead are present in the Russian River Watershed. However, Coyote Valley Dam and Warm Springs Dam block access to upstream anadromous fish habitat, alter sediment transport dynamics, and degrade water flow and temperature within the Russian River portion of the action area. CCC steelhead are also present in the coastal streams that flow directly to the Pacific Ocean in Sonoma, Marin, and San Mateo counties. Although CCC steelhead are widely distributed throughout streams in the action area, abundance levels are far below recovery targets.

2.4.3.3 Status of Green Sturgeon in the Action Area

Green sturgeon are iteroparous, and adults pass through the San Francisco Bay during spawning, and post-spawning migrations. Pre-spawn green sturgeon enter the Bay between late February and early May, as they migrate to spawning grounds in the Sacramento River (Heublein *et al*. 2009, Miller *et al.* 2020). Post-spawning adults may be present in the Bay after spawning in the Sacramento River in the spring and early summer for months prior to emigrating into the ocean. Juvenile green sturgeon move into the Delta and San Francisco Bay 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). Sub-adult and non-spawning adult green sturgeon utilize both ocean and estuarine environments for rearing and foraging. Due to these life-history characteristics, juvenile, sub-adult and adult green sturgeon may be present in San Francisco Bay year-round (Miller *et al*. 2020).

Although relatively little is known about green sturgeon distribution and abundance in the Bay, telemetry studies have been useful to understand habitat use during by juvenile, sub-adult and adult individuals. Chapman *et al.* (2019) conducted telemetry studies from 2009 to 2012 with 106 acoustic receivers deployed from the Benicia Bridge (Carquinez Strait) to the Port of Oakland to evaluate areas affected by dredging within the estuary. These results indicated that green sturgeon were present at designated dredge material placement sites and detected throughout the year (Chapman *et al*. 2019). Kelly *et al.* (2007) tracked green sturgeon movements in the Bay and found that sub-adults typically remain in shallower depths (less than 30 feet) and show no preference for temperature, salinity, dissolved oxygen, or light levels. Observations also suggest that there are two main types of movements of sub-adult green sturgeon in the estuary: directional and non-directional (Kelly *et al*. 2007). Kelly *et al*. (2020) recently described how two tagged green sturgeon utilized selective tidal transport to move throughout San Pablo Bay – swimming with the current near the surface in deeper high-current areas, and swam along the bottom in shallow areas with little current. This behavior is thought to maximize swimming efficiency and conserve energy.

Green sturgeon are encountered by recreational anglers and during sampling by CDFW in the shallow waters of San Pablo Bay. These fish are likely foraging on benthic prey and fish commonly found in soft-bottom habitats (ghost shrimp, crab, crangonid shrimp, and thalassinid shrimp) (Dumbauld *et al*. 2008). The CDFW surveys are used to estimate sturgeon (white and green) abundance, relative abundance, harvest rate, and survival rate in San Francisco Bay and the delta. Data from 2012 and 2013 show that green sturgeon abundance is low in Suisun and San Pablo bays relative to white sturgeon abundance. Green sturgeon make up approximately two to five percent of the total reported sturgeon caught in the greater Bay and lower delta. Green sturgeon catches were highest in Suisun Bay and San Pablo Bay, with very few green sturgeon reported in Central San Francisco Bay. However, this may be due to variances in fishing efforts in different locations in the Bay. Nonetheless, based on the available data, NMFS believes the overall abundance of green sturgeon in the action area is low. Freshwater habitats utilized by green sturgeon for spawning are located in the upper Sacramento River basin and are outside the action area of this project.

2.4.3.4 Status and Factors Affecting CCC Steelhead Critical Habitat in the Action Area

San Francisco Bay from the Golden Gate Bridge to the eastern end of Carquinez Strait (excludes Suisun Bay) is designated as critical habitat for CCC steelhead. Several freshwater streams within the action area are also designated as critical habitat for CCC steelhead. The PBFs of critical habitat for CCC steelhead in the estuarine portion of the action area have been degraded due to altered and diminished freshwater inflow, shoreline development, shoreline stabilization, non-native invasive species, discharge and accumulation of contaminants, loss of tidal wetlands, and periodic dredging for navigation. In the freshwater portion of the action area, PBFs of critical habitat for CCC steelhead are degraded by barriers that block migration, altered stream hydrology, loss of gravel and large wood in channels, bank stabilization, and modifications for flood control through urbanized areas. Urban and rural development in and adjacent to streams has substantially diminished habitat complexity, natural productivity, and ecological integrity in streams throughout the action area.

2.4.3.5 Status and Factors Affecting Winter-run Chinook Salmon Critical Habitat in the Action Area

Critical habitat for Sacramento River winter-run Chinook salmon includes the portion of the action area located in Suisun Bay, San Pablo and Central San Francisco Bay north of the San Francisco-Oakland Bay Bridge. Features of designated critical habitat for winter-run Chinook salmon in the action area essential for their conservation are habitat areas and adequate prey that are uncontaminated. These PBFs of designated critical habitat within the action area are degraded and limited. Habitat degradation in the action area is primarily due to altered and diminished freshwater inflow, shoreline development, shoreline stabilization, non-native invasive species, discharge and accumulation of contaminants, loss of tidal wetlands, and periodic dredging for navigation.

2.4.3.6 Status and Factors Affecting Green Sturgeon Critical Habitat in the Action Area

The San Francisco Bay portion of the action area is designated critical habitat for Southern DPS green sturgeon. PBFs for green sturgeon in estuarine areas include food resources, water flow, water quality, migratory corridor, water depth, and sediment quality. These PBFs for green sturgeon critical habitat in the action area are degraded. Habitat degradation is primarily due to altered and diminished freshwater inflow, shoreline development, shoreline stabilization, non-native invasive species, discharge and accumulation of contaminants, loss of tidal wetlands, and periodic dredging for navigation.

2.4.4. Climate Change in the Action Area

As described above in the Status of the Species and Critical Habitat section of this opinion (Section 2.2.5.1), climate change poses a threat to salmonid and sturgeon populations in central California. In the San Francisco Bay region, warm temperatures generally occur in July and August, but with climate change these events will likely begin in June and could continue through September (Cayan *et al*. 2012). Climate simulation models indicate the San Francisco region will maintain its Mediterranean climate regime for the 21st century; however, these models predict a high degree of variability in annual precipitation through at least 2050, leaving

the region susceptible to drought (Cayan *et al*. 2012). These models of future precipitation suggest that, during the second half of the 21st century in this region, most years will be drier than the historical annual average (1950-1999). As noted above in Section (2.2.5.1), California's recent long-term drought, as well as the increased incidence and magnitude of wildfires, have likely been exacerbated by climate change (Williams *et al.* 2022, Diffenbaugh *et al.* 2015, Williams *et al*. 2019).

2.4.5. Previous Section 7 Consultation in the Action Area

Numerous previous consultations pursuant to Section 7 of the ESA have occurred in the action area for a wide range of projects, including prior repairs at PG&E electrical infrastructure. For the majority of these projects, NMFS determined that they were not likely to adversely affect listed salmonids, green sturgeon or designated critical habitat. For the smaller number of projects with potential adverse effects on listed salmonids, green sturgeon, and/or designated critical habitat, NMFS determined that they were not likely to jeopardize the continued existence of listed fish nor adversely modify critical habitat. These formal consultations, where the proposed actions were likely to adversely affect ESA-listed fish species or their designated critical habitat, resulted in opinions containing RPMs to minimize the impacts of incidental take of listed fish species.

One complex formal consultation is the Long-Term Management Strategy (LTMS) for the Placement of Dredged Material in the San Francisco Bay Region. Similar to the proposed Program, the action area includes a large spatial area that overlaps with several ESA-listed fish species and their critical habitat. The LTMS Program also includes conditions for avoiding the migratory periods of listed salmonids to minimize impacts. The biological opinion for the LTMS Program was issued by NMFS to the Corps and the Environmental Protection Agency on July 9, 2015, and concluded the program of routine maintenance dredging in San Francisco Bay was not likely to jeopardize the continued existence of listed fish, or result in the destruction or adverse modification of designated critical habitat.

Research and enhancement projects resulting from NMFS' Section 10(a)(1)(A) research and enhancement permits and section 4(d) limits or exceptions could potentially occur in the action area. Salmonid and sturgeon monitoring approved under these programs includes juvenile and adult net surveys and tagging studies. In general, these activities are closely monitored and require measures to minimize take during the research activities.

2.5. Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action (see 50 CFR 402.02). A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (see 50 CFR 402.17). In our analysis, which describes the effects of the proposed action, we considered the factors set forth in 50 CFR 402.17(a) and (b).

The Corps proposes to issue an RGP that will authorize routine O&M activities on PG&E's natural gas and electrical transmission infrastructure throughout nine counties in the San Francisco Bay Area. Additionally, PG&E proposes to conduct maintenance on roads that provide access to these facilities and road maintenance will include the repair and replacement of culverts at stream crossings. O&M activities at electrical towers that would affect listed anadromous fish and designated critical habitat are located in tidal wetlands and tidal waters of San Francisco Bay. Gas line O&M and road maintenance activities are located in areas upland of San Francisco Bay and would affect freshwater streams with listed anadromous fish and designated critical habitat. The effects of PG&E's proposed O&M Program are presented below by activity type.

2.5.1. Effects of O&M Activities at Electrical Infrastructure

PG&E proposes routine maintenance the electrical transmission system in the Bay Area which consists of primary and secondary distribution lines that deliver electricity to customers. Electrical transmission lines are supported by steel-lattice towers, steel poles, and wooden poles. The majority of PG&E's electrical infrastructure in the Bay Area is located in terrestrial areas. No electrical infrastructure is located in freshwater streams. Measures proposed by PG&E in terrestrial areas are expected to prevent the discharge of contaminants and avoid disturbance of soils that could enter waterways with listed anadromous fish. Thus, electrical tower and pole repairs/replacements in terrestrial areas are anticipated to have no effect on listed anadromous fish or designated critical habitat, and this activity is not discussed further in this opinion. Similarly, no in-water work is required for line reconducting between poles and towers in terrestrial areas; thus, no effect on listed anadromous fish or designated critical habitat is anticipated with line reconductoring in terrestrial areas.

As described in Section 1.3.2 above, PG&E has categorized proposed activities at electrical transmission facilities as either "low impact" and "high impact". Proposed activities and their impact level categories are presented in Table 3. High impact activities would be conducted during the LOP (June 1 to November 30) when fewer listed species are likely to occur within the action area. Low impact activities would also be conducted between June 1 and November 30, but low impact activities may extend work until January 15, provided that these activities are initiated prior to November 30.

All electrical infrastructure work activities to be conducted under this RGP that will affect listed anadromous fish are located in tidally-influenced areas in San Francisco Bay; thus, the effects analysis presented in this section applies to the San Francisco Bay estuarine portion of the action area. All four listed anadromous salmonid species addressed in this opinion (CCC steelhead, CCV steelhead, CV spring-run Chinook salmon, and Sacramento River winter-run Chinook salmon) occur in San Francisco Bay during the winter and spring months. The Southern DPS of green sturgeon) occur in San Francisco Bay year-round. Additionally, all of San Francisco Bay is designated critical habitat for the Southern DPS of green sturgeon and portions of the Bay are designated as critical habitat for Sacramento River winter-run Chinook and CCC steelhead. See Section 2.4.3 of this opinion for additional information regarding the status of listed species and critical habitat in the estuarine portion of the action area.

2.5.1.1 Cofferdam Installation and Dewatering

Many O&M Program activities at electrical towers will require dewatering of the work site to facilitate construction. Specifically, tower foundation repairs and replacements can require the installation of a cofferdam to isolate the work area from tidal waters. Placement of a cofferdam has the potential to entrap listed fish during the final stages of installation when the area within the cofferdam is closed off.

PG&E proposes to scheduled cofferdam installation and closure activities during periods of low tide to minimize the amount of water and fish contained within the cofferdam. At most sites, low tide conditions will result in the site being naturally dewatered and there is little risk of fish entrapment when the cofferdam is closed at these shallow water locations. PG&E reports that 92% of the electrical tower foundations in San Francisco Bay are located in water depths at or above MLLW. At sites where water remains within the cofferdams following closure, pumps with fish screens will be deployed. As the area within the cofferdam is dewatered, fish collection will be performed with seines, hand nets, dipnets, and traps. Captured fish will be relocated to suitable aquatic habitat areas outside of the work area in adjacent estuarine waters.

Listed fish that avoid capture during dewatering activities and remain within the cofferdam are likely to be killed by stranding or contact with construction equipment. However, few fish are likely to avoid capture due to the limited amount of hiding cover within each work area. Listed anadromous salmonids are unlikely to be present in the estuary during the period when cofferdams are installed (i.e., June 1 to November 30). Thus, NMFS expects that the entrapment of listed salmon or steelhead in a cofferdam to be improbable. Green sturgeon in the estuary are generally larger than 16 inches in length and should be relatively easy to locate if entrapped within a cofferdam. Fish collections overseen by a qualified biologist are expected to effectively capture and relocate any green sturgeon that may be entrapped within a dewatered cofferdam (see Section 2.5.1.2 below).

Another manner by which fish may be harmed or killed during dewatering activities is to be entrained into the pumps used for dewatering. NMFS expects that entrainment or impingement of listed fish at dewatering pumps will be improbable because PG&E will place screens which meet NMFS intake screen criteria for anadromous salmonids on all water pumps.

Benthic (*i.e.*, substrate dwelling) aquatic macroinvertebrates (i.e., prey of listed fish species) within the Program site will be killed or their abundance reduced when benthic habitat is dewatered within a cofferdam. However, effects to aquatic macroinvertebrates resulting from dewatering will be temporary because construction activities will be relatively short-lived (i.e., not to exceed 35 days at an electrical tower). However, larger scale effects to the benthic community are expected from Program activities and are discussed in Section 2.5.1.6 of this opinion.

2.5.1.2 Fish Handling

During dewatering of areas internal to cofferdam sites, PG&E proposes to capture and relocate fish away from work sites to avoid mortality and minimize the possible stranding of fish within cofferdams. Fish will be captured by seines, hand nets, dip nets, and traps, then transported and

released to nearby suitable habitat. As presented above, listed anadromous salmonids are unlikely to be captured due to the timing of cofferdam installations. However, green sturgeon are present in the estuary year-round and may be entrapped as a cofferdam is closed. Data to precisely quantify the number of green sturgeon that will be collected and relocated from cofferdams is not available, but is expected to be low due to the relatively small number of green sturgeon within the estuary, their wide distribution throughout the estuary, and they are likely to respond behaviorally to construction activities by swimming away from active work sites.

Fish relocation activities pose a risk of injury or mortality to rearing juvenile fish. Any fish collecting gear, whether passive (Hubert 1996) or active (Hayes *et al*. 1996) has some associated risk to fish, including stress, disease transmission, injury, or death. The amount of unintentional injury and mortality attributable to fish capture varies widely depending on the method used, the ambient conditions, and the expertise and experience of the field crew. Potential stress, injury, and mortality of captured and handled green sturgeon during fish relocation will be lessened by the use of qualified biologists. Despite protective measures, NMFS expects the capture, handling and transport of fish will result in stress and potentially injury of a small number of green sturgeon individuals.

Information regarding the mortality of green sturgeon associated with capture and handling is available from annual reports submitted by researchers operating under ESA section 10(a)(1)(A) permits and Exemption 1 of the Southern DPS green sturgeon 4(d) rule. These reports indicate mortalities of green sturgeon associated with handling are very low. The June 2, 2022, NMFS biological opinion for evaluation of research programs submitted for consideration under the ESA's section 4(d) Rule summarized ten years of annual reporting by sturgeon researchers (NMFS 2022). Compilation of these reports showed no mortalities of adult green sturgeon in the ten-year period extending from 2011-2020. Mortalities of juvenile green sturgeon were limited to one event in 2016 where 77 juvenile green sturgeon were captured and 10 were killed unintentionally. All other researchers reported zero mortalities associated with the capture of juvenile green sturgeon in the 10-year period from 2011-2020 (NMFS 2022). Based on this information, it is anticipated that the collection and relocation of adult and juvenile green sturgeon during PG&E's relocation of fish from dewatered cofferdams will result in no mortalities absent an unintentional accident; although stress and sublethal injury will temporarily affect individuals. Recovery of handled individuals is expected to be rapid following relocation in waters adjacent to work sites.

2.5.1.3 Underwater Sound

Elevated levels of underwater sound levels are expected during pile driving in tidal waters. Sheet piles will be installed for cofferdam construction and steel piles installed for tower repairs/replacements. PG&E has proposed prioritizing the use of vibratory hammers, but may also utilize helical pile drivers and impact hammers to install piles.

Fish 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 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 sound 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 over-stimulate 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 or 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 results from an 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 behavior 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 to 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 interim acoustic criteria for the 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 level (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 of 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 and listed salmonids is appropriate.

Different types of piles (e.g., wood, steel, concrete) and different drivers (e.g., impact, vibratory, helical) result in wide range of underwater sound levels. Impact hammers produce the highest elevated underwater sound levels, particularly when used in combination with steel piles. Vibratory hammers produce less sound 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 (Buehler *et al.* 2015). Based on the results of hydroacoustic monitoring conducted in San Francisco Bay (Molnar *et al.* 2020), use of vibratory hammers is not expected to produce sound levels that exceed the dual metric criteria described above. Similarly, the use of helical pile driving is not expected to produce sound levels that will exceed the dual metric criteria because this method of installation screws piles into the substrate instead of being driven with a hammer. Sheet piles for cofferdam construction will only be installed by vibratory hammer.

2.5.1.4 Pile Driving in Tidal Waters

As described in Section 1.3.2 of this opinion, high impact activities, such as the use of an impact hammer or dewatering, would be scheduled to occur between June 1 and November 30 to avoid overlap with the primary migratory periods for listed steelhead and salmon in San Francisco Bay. However, unforeseen circumstances may lead to the Program continuing and completing some activities after November 30. Listed salmon and steelhead are generally not present in the Bay until the winter and spring months; thus, PG&E Program activities that continue after November 30 will exposed listed anadromous salmonids to elevated levels of underwater sound. However, O&M Program activities may only extend a maximum of six additional weeks after November 30 because all work must be completed each year by January 15. Green sturgeon, both juveniles and adults, will occur in the action area year-round and would potentially be exposed to the effects of pile driving throughout the year.

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 the Program's construction activities will occur during the driving of the 60-inch and 72-inch steel pipe piles with an impact hammer, and thus, impact the largest area. During implementation of the Program, tower repairs and replacements could occur at as many as 17 sites per year, and PG&E will utilize piles as large as 72-inches in diameter. Therefore, our analysis assumes that the largest and loudest piles (60-inch and 72-inch) will be used at up to 17 sites per year. In the project's biological assessment, PG&E examined hydroacoustic monitoring results for similar sized piles and in similar conditions presented in the Technical Guidance for the Assessment of Hydroacoustic Effects of Pile Driving on Fish (Molnar *et al.* 2020).

To estimate the peak SPL and cSEL that will occur during pile driving at PG&E tower foundation repair/replacement sites, NMFS used proxy sound levels contained in the NMFS Optional Multi-Species Pile Driving Calculator, Version 1.2-Multi-Species 2022

(https://media.fisheries.noaa.gov/2022-08/BLANK%20Multi-Species%28AUGUST%202022%29PUBLIC_OPR1.xlsx). Most of the proxy values presented in the NMFS Optional Multi-Species Pile Driving Calculator were obtained from Molnar *et al.* (2020). We used this calculator because it provides a conservative and consistent method for estimating sound pressure levels at distance from pile driving, and is appropriate for projecting underwater sound levels at multiple locations throughout the San Francisco Bay

Calculator results are presented in Table 7 and show estimates of distance from a pile to peak SPLs and cSELs (*i.e.,* NMFS dual metric criteria) during impact hammer pile driving of steel piles ranging from 16 inches to 72 inches in diameter. Proxy values were selected from pile driving projects with the same pile type/size and similar water depths. The underwater sound estimates in Table 7 also incorporate sound attenuation by use of an air bubble curtain or cofferdam. 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. If a cofferdam is used, dewatering of the area around the pile will attenuate sound propagation during pile driving. Therefore, the sound level estimates presented in Table 7 include 5 dB of sound attenuation. It should be noted that hydroacoustic monitoring of individual projects have reported 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. Cofferdams are thought to provide as great, if not greater, attenuation than bubble curtains; however, some acoustic monitoring has provided mixed results. 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 and cofferdams.

Table 7. Projected Impact Hammer Sound Levels with Steel Piles*

Steel Pile Size	Distance (ft) to 206 dB peak	Distance (ft) to 187 dB accumulated SEL/day	Distance (ft) to 150 dB RMS
16-inch	0	30	243
20-inch	20	446	4,458
24-inch	10	552	7,065
36-inch	20	827	7,065
60-inch	30	1,778	15,226
72-inch	30	1,309	15,226

*5 dB reduction assumed for sound attenuation with use of air bubble curtains or cofferdams. All examples in water depths $\leq$ 17 feet and calculations are for 2,000 strikes/day.

The calculator utilized by NMFS predicts SPLs from a pile driven with an impact hammer during O&M Program activities could exceed the 206 dB peak single strike threshold for a distance of up to 30 feet. At this close range, several factors make it unlikely that listed salmonids or green sturgeon will be adjacent to a pile during driving with an impact hammer. If a cofferdam is deployed, PG&E will use plywood or metal sheets to dewater the work site and fish

will not have access to the area immediately surrounding the pile. If a bubble curtain is used, placement of the curtain will occupy about 5-10 feet of the radial distance outward from the pile. Activation of the air bubble curtain prior to the initiation of pile driving is expected to startle fish adjacent to the pile and likely result in a flight response. Although most fish are likely to perceived these construction activities as a stimulus indicating potential danger in its immediate environment, not all fish may flee the area. Thus, there remains a distance up to 30 feet from a pile where peak sound levels are expected to exceed 206 dB and a small number of listed fish in this area are expected to be injured or killed by barotrauma.

In addition to peak sound levels exceeding 206 dB, cSEL is expected to result in injury or mortality of listed fish and cSEL will extend for a significantly greater distance from the pile. In general, the larger the pile diameter, the greater the distance and larger the area impacted by underwater sound levels during driving with an impact hammer. Information available to estimate cSEL for this Program indicates the greatest distance will occur during the driving of 60-inch piles (Table 7). The calculator predicts the extent of SPLs above a cSEL of 187 dB would extend up to a radial distance of approximately 1,778 feet from a 60-inch pile, and encompass the active working area under and around each pile location. For 72-inch piles, cSEL of 187 dB is projected to extend to a distance of 1,309 feet. For the purposes of this analysis, the zone of potential injury or mortality to listed fish is associated with a cSEL equal to or greater than 187 dB and is defined as the area in which fish could experience a range of barotraumas, including the 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 within San Francisco Bay, some individuals are expected to be exposed to elevated sound levels during pile driving activities at PG&E electrical tower work sites in the San Francisco, San Pablo and Suisun bays. Similarly, if the Program needs to complete work with an impact hammer outside of the LOP, then listed salmonids would also be subjected to elevated sound levels. NMFS estimates that only a very small number of threatened Southern DPS green sturgeon would likely be injured or killed by the proposed pile driving because few individuals are likely to be exposed to a cSEL of 187 dB or greater. To incur injury or mortality, an individual fish would need to remain continuously within the zone of cSEL (see Table 7) for an extend period of time during pile driving. Thomas *et al*. (2022) examine the movement patterns of juvenile green sturgeon in San Francisco Bay and concluded that there are multiple behavioral movement patterns and a broad use of regional habitats. With this widespread distribution of green sturgeon throughout the Bay, pile driving activities by the O&M Program may expose sturgeon to the impacts of pile driving at any of the electrical tower work sites.

Similarly, NMFS estimates that a very small number of listed salmonids are likely to be injured or killed by high cSEL during the driving of steel piles, because this high impact activity would generally not occur when migrating salmonids are present in San Francisco Bay. Pile driving that occurs after November 30 will overlap with the adult upstream migration periods of Sacramento River winter-run Chinook salmon, CCV steelhead and CCC steelhead. However, adult upstream migrating Chinook and steelhead rapidly pass through the Bay on their way to their natal spawning streams. Adults salmonids in the Bay also make little use of shallow and nearshore

habitats where most pile driving will occur, and therefore, will be exposed to injurious levels of underwater sound in very small numbers. Juvenile and smolt listed anadromous salmonids are more likely to use nearshore habitats in the Bay for rearing and foraging, but the work window will prohibit pile driving activities from occurring after January 15 when juvenile and smolt salmonids are most likely to be present in the Bay.

Within the zone of cSEL of 187 dB (e.g., up to a maximum of 1,778 feet with a 60-inch pile being driven), most exposed listed fish are unlikely to remain in the same location to experience the full duration of a pile driving event due to tidal currents and behavioral movements. However, a few listed fish individuals could remain stationary long enough to be exposed to levels which cause injury or mortality. Although no data are available to quantify the risk of exposure to the cSEL threshold of 187 dB, some listed salmonids and sturgeon are expected to be injured or killed due to the large number of PG&E facilities throughout the action area that may be repaired or replaced during the 10-year duration of the proposed O&M Program.

PG&E also proposes to utilize vibratory hammers and helical pile driving. 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 (Molnar *et al.* 2020). Based on the results of hydroacoustic monitoring of vibratory hammer pile installations (Molnar *et al.* 2020), the sound levels generated by vibratory hammer use over the course of this Program will be considerably below the injury and mortality thresholds for both single strike and cSEL. Helical pile driving involves turning, or screwing, large piles into the substrate instead of using a hammer. This is a relatively new technology and sound levels associated with this method are expected to be less than those associated with pile driving hammers (Byrne and Houlsby (2015). Effects associated with vibratory hammers and helical pile driving during O&M Program activities are expected to be temporary behavioral effects that are discussed below.

Beyond the zone of potential injury or mortality, sound levels are projected to exceed 150 dB RMS to a maximum distance of 15,226 feet during the impact driving of 60-inch and 72-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 16,000 acres for the 60-inch and 72-inch diameter piles.

If listed fish enter or transit the behavior impact zones described above during pile driving, there could be behavioral reactions. Fish may leave the area or 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 listed fish species, like other fish studied, will exhibit startle and avoidance behavioral reactions by swimming away from the work site. If elevated SPLs during pile driving result in a level of disturbance that causes salmonids and green sturgeon to leave or avoid the zone of behavioral impacts, foraging and migrating could be interrupted. Assuming the worst-case scenario, elevated sound levels could

render the behavioral impact zone unusable by listed fish during the hours when pile driving operations are underway.

For the Program's use of an impact hammer to install steel piles, no more than 2,000 strikes would be applied per day at each work site. As described above in Section 2.4, the action area provides soft bottom, sub-tidal foraging habitat for green sturgeon and juvenile listed salmonids forage within the upper portion of the water column. This temporal loss of foraging area will affect green sturgeon. Individuals could be displaced from preferred forage areas until each day's pile driving activities have concluded.

Similar to foraging behavior, the zone of behavioral impacts during pile driving may affect the migration of adult salmonids and green sturgeon. In particular, impact hammer pile driving at electrical tower sites within narrow channels or confined sloughs could create a zone of behavioral impacts that spans the channel width, and cause delays and disruption of migration movements. Based on the location of PG&E's electrical towers in San Francisco Bay (Figure 1), the zone of behavioral impacts during pile driving could span the width of Mare Island Strait and the lower Napa River. Migrating listed fish attempting to pass through the zone of behavioral effects during the period of 60- and 72-inch pile driving may temporarily stop migrating or shift their migration path.

If a behavioral response results in a delay/shift in migration or movement away from foraging areas, the duration of these behavioral effects is expected to be short because the Program will only use one impact hammer at a time with no more than 2,000 strikes per day. Depending on the site and type of pile, an impact hammer typically strikes the pile at a rate of once every 1.5 to 2 seconds (Molnar *et al.* 2020). Thus, pile driving events and the associated elevated underwater sound levels will be brief. These short temporary delays/detours to migration and displacement from foraging areas within the zone of behavioral impacts are not expected to result in adverse effects because fish are expected to safely return to these areas and continue migration movements when pile driving ceases. Additionally, high ambient levels of underwater sound in San Francisco Bay are likely to mask the noise of pile driving in the zone of behavioral influence as presented below.

In San Francisco Bay, ambient sound levels are reported to range from 120-155 dB peak (Strategic Environmental Consulting, Inc. 2004, as reported in Molnar *et al.* 2020). Thus, ambient sound levels in the action area are likely similar at times to the 150 dB RMS levels anticipated to occur inside the zone of behavioral effects during pile driving. With this level of ambient sound in the environmental setting of San Francisco Bay, elevated sound levels due to this Program's activities within the zone of behavioral effects may be hard to distinguish from other anthropogenic sources of sound, such as commercial vessels and recreational boats. Thus, elevated sound levels of 150 dB RMS originating from the installation of steel piles by this Program may not result in an avoidance response by listed fish. If there are behavioral responses, the effects of 150 dB RMS will be short term and the temporary delays to migration or displacement from a foraging area are expected to be negligible on listed fish. Based on the above, the temporary behavioral effects described above during pile driving are not expected to result in adverse effects to green sturgeon and listed anadromous salmonids.

Program O&M activities may also install wooden piles to repair or replace electrical infrastructure in the action area. Wooden piles are typically installed with a drop hammer and a cushion block is used between the hammer and the pile. Hydroacoustic monitoring of wooden pile installations have occurred in San Francisco Bay and results reported in Molnar *et al*. (2020). Monitoring results indicated that underwater SPLs from wood piles installed with an impact hammer do not reach the dual metric criteria for fish injury or mortality. Peak sound levels at 33 feet from the pile were generally in the range of 170 to 180 dB, and RMS levels generally ranged from 160 to 170 dB. Therefore, installation of wood piles by the Program are not expected to result in the injury or mortality of listed fish; however, elevated underwater sound levels during the installation of wooden piles will disturb listed fish and result in the disturbance effects described above for steel piles.

PG&E also proposes to use concrete piles at some locations for Program activities. Concrete piles would be cast in place using a hollow steel pile as the casing or form. Thus, installation of a concrete pile would always be preceded by the driving of a hollow steel pile and the effects of steel pile installation are described above. Filling of the hollow steel pile with concrete may affect water quality and potential effects of concrete use by the Program are presented below in Section 2.5.1.5 of this opinion.

2.5.1.5 Line Reconductoring in Tidal Waters

To perform line reconductoring between electrical towers in tidal waters, the O&M Program may use barges and/or helicopters. Work crews install replacement conductors by temporarily splicing them to the ends of the existing conductors and pulling them through travelers (i.e., pulleys) attached to the arms of the towers or pole cross-arms. Reconductoring typically is conducted in 2 to 3-mile sections and on-water pull sites will be located on work barges. Aside from utilizing a work barge, no in-water work is associated with line reconductoring activities.

During line reconductoring activities in shallow water areas, barges will utilize periods of high tide to minimize contact with the bottom of San Francisco Bay, as the barges must navigate along the transmission line in a manner that allows crews to work from the barge platform. When the barges are not in use, they will be docked at existing marina/dock facilities or landed in areas that avoid disturbance of submerged aquatic vegetation and wetland vegetation (NOAABA-AMM-01). For these reasons, disturbance of the substrate by work barges during line reconductoring is expected to be minimal. Benthic habitat disturbance by barges and other O&M activities is discussed further in Section 2.5.1.7 below. Because barges move slowly when working or relocating to and from work sites, any fish swimming near the surface that encounter a barge would be able to easily avoid the barge. Thus, NMFS believes it improbable that any listed fish would be struck by a barge. Any changes in habitat caused by shading from the barge on the water's surface would be minimal and temporary.

Use of helicopters during line reconductoring will result in elevated levels of sound in the air above the water surface. The extent of transmission of this sound to areas underwater is unknown but may be detected by listed fish in Bay waters. As discussed above in Section 2.5.1.3, sound exposures have been shown to alter the behavior of fishes (see review by Hastings and Popper 2005). Observed behavioral changes include startle responses and increases in stress hormones. With high levels of ambient sound in San Francisco Bay (reported to range from 120-155 dB

peak [Strategic Environmental Consulting, Inc. 2004, as reported in Molnar et al. 2020]), any elevated underwater sound levels due to operation of helicopters during line reconductoring are expected to have negligible effects on the behavior of listed salmonids and green sturgeon. If there are behavioral responses, the effects are anticipated to be short term and temporary.

2.5.1.6 Water Quality

Water quality in the estuarine portion of the action area may be degraded at electrical infrastructure work sites during the Program's construction activities. Disturbance of soft bottom sediments during the removal of existing piles and installation of new piles, and the construction of cofferdams is expected to result in temporary increased levels of turbidity. Additionally, water quality may be degraded through the suspension of sediment-associated contaminants in the water column. Program activities also include the use of concrete at tower foundations and to construct concrete piles.

Water quality in the freshwater portion of the action area may be affected by the O&M Program's access road maintenance activities. The effects of routine road maintenance activities on water quality are presented in Section 2.5.3 below.

Turbidity and Suspended Sediment

High concentrations of suspended sediment can disrupt normal feeding behavior (Cordone and Kelley 1961, Bjornn *et al*. 1977, Berg and Northcote 1985, Benfield and Minello 1996), reduce growth rates (Crouse *et al*. 1981, Nightingale and Simenstad 2001), and increase plasma cortisol levels (Servizi and Martens 1992). High and prolonged turbidity concentrations can reduce dissolved oxygen in the water column, result in reduced respiratory functions, reduce tolerance to diseases, and can also cause fish mortality (Sigler *et al*. 1984, Berg and Northcote 1985, Gregory and Northcote 1993, Velagic 1995, Waters 1995). Even small pulses of turbid water can cause salmonids to disperse from established territories (Waters 1995), which can displace fish into less suitable habitat and/or increase competition and predation, thus decreasing chances of survival.

As piles are driven and removed from the Bay substrate by the Program, fine-grain sediments such as clay and silt material will be disturbed and generate increased levels of turbidity in the adjacent water column. Sheet piles and plywood installed for the construction of temporary cofferdams will also disturb the Bay floor and distribute sediment into the water column. The extent of turbidity plumes resulting from Program construction will depend on the substrate, tide, currents, and wind conditions during these activities.

Based on observations of similar pile and cofferdam activities in the San Francisco Bay, increased levels of suspended sediment and turbidity during this Program's construction activities are anticipated to be minor, localized, and short-term. With strong tidal currents in the majority of the action area, any elevated levels of suspended sediment or turbidity are anticipated to rapidly return to background levels after work ceases. In areas with lower rates of tidal exchange, elevated levels of suspended sediments and turbidity will be detectable for two or three tidal cycles prior to returning to ambient levels.

Based on the anticipated extent and levels of turbidity associated with construction activities by the Program, the effects are not expected to result in harm or injury, or behavioral responses that impair migration, foraging, or make listed fish more susceptible to predation. If fish temporarily relocate from areas of increased turbidity, habitat of similar value is available in the surrounding waters adjacent to the PG&E work sites in the action area. Adjacent habitat areas also provide adequate carrying capacity to support individual fish that are temporarily displaced during in-water construction activities that cause increases in turbidity and suspended sediment. For these reasons, the potential effects on listed fish species of minor and localized areas of elevated turbidity and suspended sediment associated with this Program's construction activities are expected to be negligible.

Contaminants

As described above in the Environmental Baseline, 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 the 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). Tire shreds/dust that produce a degradation product (6PPD-quinone) have been found to be ubiquitous where urban roadways drain into waterways (Feist *et al*. 2018, Sutton *et al.* 2019). 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 and cofferdams, bottom sediments will be suspended and contaminants may be released to the water column. However, based on the types of activities conducted by the Program, the short duration of activities at each work site, and equipment to be 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 ESA-listed fish species.

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 (PAH) and metals. Both can result in adverse impacts to fish. The Program will have in place spill and prevention measures designed to avoid contamination from equipment refueling, leakage, maintenance or other activities. NMFS anticipates the Program's proposed measures to prevent contamination will adequately protect water quality and avoid adverse effects by contaminants on listed fish.

Use of Concrete

The repair or replacement of tower foundations will involve the pouring and curing of concrete, which can result in increased pH levels in adjacent waters. Exposure to variations in pH in the aquatic environment can result in impacts to fish in the form of gill damage, disruption of

sodium balance, ammonia excretion or in some cases the increased toxicity of other elements in the aquatic environment (McLeay and Associates 1983, Baekken 2014, Foldvik *et al.* 2022). As described in Section 1.3.5, the release of uncured concrete into the water would not be allowed during repair or replacement of electrical infrastructure. All concrete will be contained within forms, for at least 24 hours, to prevent wet concrete from leaching into the aquatic environment. With implementation of the Program's proposed avoid and minimization measures, the risk of increased pH and subsequent impacts to fish and other aquatic organisms in the estuary would be avoided.

2.5.1.7 Benthic Habitat

Disturbance of benthic habitat by PG&E O&M activities has the potential to affect foraging and prey availability for listed fish. Green sturgeon forage throughout the estuarine portion of the action area on demersal fish and benthic invertebrates. 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). In San Francisco Bay, green sturgeon are known to forage in shallow tidal flats dominated by burrowing shrimp and other benthic prey (Dumbauld *et al.* 2008).

For Chinook salmon and steelhead, research indicates salmonid juveniles that use the estuary for rearing appear to prefer shallow water habitats near the shore and the upper portion of the water column (less than 10 feet deep) (Kjelson *et al.* 1982). In the action area of this project, salmonid juveniles have been observed rapidly migrating to the ocean (MacFarlane and Norton 2002), but some juvenile Chinook and steelhead are likely to forage during their migration through San Francisco Bay and feed upon prey items nearshore and in the upper water column. Prey organisms in the upper water column are unlikely to be affected by the Program's activities that disturb benthic habitats. Although benthic disturbance near the shoreline and in tidal marshes have the potential to impact prey of juvenile salmonids in the estuary.

Several proposed O&M Program activities are likely to disturb benthic habitats and the associated community of benthic organisms. The Program's installation and removal of cofferdams and pilings are expected to injure and kill benthic invertebrates that are directly in the footprint of these activities. Cofferdams will temporarily close-off areas and benthic habitat within the enclosures will be disturbed. Work barges that rest on the substrate during low tide will disturb benthic habitat; however, disturbance of the substrate by barges is expected to be minimal and barges in shallow areas will be placed to avoid disturbance of submerged aquatic vegetation and wetland vegetation (NOAABA-AMM-01). Permanent loss of benthic habitat will result from fill associated with new and expanded tower foundations and boardwalks. However, in some instances the installation of these structures will include removal of older, existing structures and there may be little change in the total area of infrastructure on the bay floor. Placement of mats on the substrate during work activities will temporarily cover areas that contain burrowing benthic invertebrates.

At individual work sites the extent of impacts to the benthic community is expected to be small areas immediately surrounding each tower repair/replacement project; although the area affected will be larger if a cofferdam is constructed. PG&E estimates the average footprint of impact at each site is limited to 500 square feet; however, due to the large number of facilities, the

Program's biological assessment estimates proposed activities will annually result in temporary impacts of up to 0.58 acre of habitat (PG&E 2022). Permanent impacts associated with the repositioning/relocation of tower footings and foundations are anticipated to be approximately 0.08 acre of surface area annually (Table 6).

For aquatic benthic invertebrates injured and lost to construction disturbance, sites are expected to be re-colonized within a few months from adjacent undisturbed areas. Although as many as 17 sites may have work performed in a single year, the sites are dispersed throughout a large geographic area and impacts are primarily temporary. NMFS does not expect this temporary loss of benthic prey in the action area will prevent sturgeon and listed salmonids from finding suitable forage at the quantities and quality necessary for normal behavior (e.g., maintenance, growth, reproduction). Permanent loss of benthic habitat where foundations and/or tower footings are relocated is also not expected to adversely affect prey availability and foraging by listed fish because the area impacted is low (approximately 0.08 acre per year), and in some instances abandoned electrical infrastructure will be removed.

To mitigate for permanent impacts to habitat, PG&E intends to contribute funds that will be used for projects to improve fish passage and/or fish habitat within San Francisco Bay and freshwater migratory corridors within the greater San Francisco Bay Area. These mitigation projects would obtain approval from the Corps through separate permits and their effects are not considered in this opinion because they will be addressed in future consultations pursuant to section 7 of the ESA.

2.5.1.8 Effects of O&M Activities at Electrical Infrastructure on Critical Habitat

As described in Section 2.5.1 of this opinion, the O&M Program includes maintenance of electrical transmission lines that are supported by steel-lattice towers, steel poles, and wooden poles. The majority of PG&E's electrical infrastructure in the Bay Area is located in terrestrial areas. No electrical infrastructure is located in freshwater streams and no electrical infrastructure maintenance activities would be conducted in streams. Measures proposed by PG&E in terrestrial areas during work on electrical towers and poles are expected to prevent the degradation of water quality in streams designated as critical habitat for listed anadromous fish. Thus, electrical tower and pole repairs/replacements in terrestrial areas are anticipated to have no effect on designated critical habitat.

Electrical infrastructure O&M activities authorized by this RGP that will affect critical habitat for listed anadromous fish are located in tidally-influenced areas in San Francisco Bay. The San Francisco Bay estuarine portion of the action area is designated as critical habitat for Southern DPS green sturgeon, Sacramento River winter-run Chinook salmon, and CCC steelhead (see Section 2.4.3 of this opinion). Program activities are expected to temporarily alter water quality and impact benthic habitat at work sites in designated critical habitat.

Water Quality

The effects of Program construction activities on water quality are discussed above in Section 2.5.1.5 of this opinion and also apply to designated critical habitat in the action area. As described above, the effects of the proposed Program will result in increased levels of turbidity

and the suspension of sediment-associated contaminants. The impacts on water quality from turbidity and contaminants are not expected to degrade PBFs of ESA-listed fish species because the level of potential contaminants and turbidity is low, and both turbidity and contaminant-laden sediments are expected to be further dispersed (levels reduced) by tides and currents in the action area. The effects of the degradation product (6PPD-quinone) associated with tire shreds are unlikely to be exacerbated by O&M Program activities. Thus, effects of degraded water quality on designated critical habitat are expected to be short-term, minor, and localized.

Benthic Community

The effects of Program activities on benthic habitat are discussed above in Section 2.5.1.6 of this opinion. The Program's installation and removal of cofferdams and pilings are expected to injure and kill benthic invertebrates which could degrade the PBFs of critical habitat associated with foraging. In areas where benthic habitat disturbance is temporary, benthic invertebrates are expected to re-colonize work sites within a few months. Permanent impacts associated with the relocation or expansion of electrical tower foundations would result in the loss of benthic habitat and are estimated to be up to 0.08 acres annually. This permanent habitat loss will be dispersed throughout a large geographic area and sites are non-contiguous. For the reasons presented above and in Section 2.5.1.6 of this opinion, the small disconnected areas of permanent benthic habitat loss by the 10-year program will degrade PBFs of designated critical habitat for the Southern DPS green sturgeon, Sacramento River winter-run Chinook salmon, and CCC steelhead, but not significantly compromise the value of foraging habitat in this large geographic area.

2.5.2. Effects of O&M Activities at Natural Gas Infrastructure

Natural gas infrastructure O&M work activities to be conducted under this RGP that will affect listed anadromous fish are primarily located in the channels of freshwater streams upland from San Francisco Bay, but a small number of gas lines are located in tidal wetlands or estuarine waters (see Table 5 for waterways with gas line crossings). Of the five listed anadromous fish species addressed in this opinion, only CCC steelhead and their designated critical habitat occur in the freshwater portion of the action area. Gas line activities in tidal areas affect CCC steelhead and will also affect CCV steelhead, Sacramento River winter-run Chinook, CV spring-run Chinook, and Southern DPS green sturgeon.

Natural gas line O&M activities consist of site-specific erosion measures over pipelines, pipeline recoating, pipeline replacement, valve recoating, and valve replacement. These activities will affect listed anadromous fish and/or designated critical habitat at gas line crossings in freshwater channels and in tidal wetland areas. PG&E's pre-construction notifications for individual O&M activities will identify specific locations and specify whether or not listed anadromous fish or designated critical habitat may be present at gas line crossing work sites.

The proposed O&M activities associated with gas line infrastructure generally involve the excavation of materials to expose the gas line or valve, performing the recoating or replacement work (valve or pipeline), and then replacing the excavated materials to re-bury the pipeline. For site-specific erosion protection, biodegradable jute netting and other non-hardscape materials will be placed on exposed sections of pipeline in the stream channel to prevent further erosion. PG&E proposes to limit O&M activities associated with gas line crossings at waterways with

listed anadromous fish to periods when the work sites are naturally dry (see NOAABA-AMM-13). By restricting gas line maintenance to sites that are naturally dry, no dewatering with cofferdams will be required. and the potential adverse effects associated with excavation and trenching in wetted areas will be avoided.

Some gas line crossing sites included in Table 5 are located on waterways that do not seasonally dewater during the dry season and these locations are specified on the table as "likely to support year-round flow". At these sites, traditional excavating and trenching methods will not be conducted and PG&E will develop alternative methods for repairing or replacing gas lines. The RGP will not authorize in-water work at these pipeline crossing sites. With PG&E only employing methods that avoid work in channels at crossings with year-round flow, no effects to listed anadromous salmonids and green sturgeon are anticipated at these sites with year-round flow.

Effects on Fish

In tidal wetlands, work on gas line infrastructure would only be performed at sites that are located in high marsh areas. Some high marsh areas would be inducted at extreme high tides, but O&M Program work activities would be scheduled to avoid extreme tide events and be completed without effecting tidal waters. Similarly, on freshwater streams O&M activities on gas lines would be scheduled for the dry season when work sites are naturally dry. No dewatering would be performed to conduct these O&M activities. Under all water year conditions, O&M activities would be scheduled to ensure work is performed when anadromous salmonid streams contain no flowing water at work sites. At gas line valves, excavation of soils to expose valves located near waterways with listed anadromous fish would be performed without disturbing the stream or tidal channel. If work activities impact riparian vegetation, sites will be revegetated with native plant species in a manner consistent with maintaining safety at PG&E's infrastructure.

By avoiding periods when work sites may be inducted by high tides and only working in stream channels that contain no flowing water, no listed fish will be present during work activities on natural gas infrastructure. Construction activities are expected to proceed with no immediate effects on listed fish and no discharge of construction debris into waters with listed fish because no water will be present. O&M activities would be completed before the return of tidal inundation in estuarine areas and prior to the return of fall/winter surface flow in freshwater streams. Thus, no impacts to listed fish would occur during construction activities on gas line infrastructure.

Water Quality

Post-construction, minor turbidity will occur in waters at work sites when the site is re-watered during the following wet season with rainfall or during extreme high tide events in tidal wetlands; however, PG&E's use of erosion control measures and plantings of native vegetation are expected to minimize the mobilization of sediments from areas disturbed by construction activities. The resulting increase in turbidity levels in the waterways is expected to be minor and rapidly dissipate to ambient levels. For these reasons, the effects of O&M activities at gas line infrastructure on listed anadromous fish from changes in water quality in the action area are expected to be negligible.

Channel Form and Function

Site-specific erosion solutions on gas line crossings in waterways with listed anadromous fish could contribute to the long-term preclusion of natural fluvial and geomorphic processes. For example, in most low gradient streams the channel will naturally "meander", eroding laterally to dissipate its hydraulic energy while creating a sinuous longitudinal course. Stream meandering efficiently regulates the erosive forces by lengthening the channel and reducing stream gradient, thus controlling the ability of the stream to entrain and transport available sediment. Meandering streams also create and maintain both the hydraulic and physical components of instream habitat used by fish and other aquatic species. Specific to salmon and steelhead, a meandering, unconstrained stream channel sorts and deposits gravel and other substrate necessary for optimal food production and spawning success, maintains a healthy and diverse riparian corridor that supplies large woody debris to the channel, and inundates adjacent floodplain habitat during appropriate winter/spring flows (Spence *et al.* 1996).

Proposed site-specific erosion solutions at gas line crossings could result in small-scale permanent alteration of channel morphology by altering the physical land/water interface (i.e. streambank) that provides shelter, food, and other ecosystem benefits to aquatic species, including juvenile salmonids. Channel hydraulics could also be affected at erosion solution sites if the channel width is reduced. Channel constrictions, particularly with hardscape, can increase water velocities and cause corresponding increases in shear stress and degradation along stream banks (Simon and Johnson 1999).

For erosion protection actions authorized by this RGP in waterways with listed anadromous fish, PG&E would not utilize hardscape materials. Erosion protection projects would not span more than 20 percent of the active channel width and not exceed 500 square feet per site. Materials, such as jute netting, straw waddles, native plants and hydroseeding will be placed in the channel in a manner that avoids the constriction of flow and will not increase water velocities (NOAABA-AMM-14). These limits on the extent of erosion protection actions will avoid channelization and impairment of natural channel processes. These measures will also ensure fish passage and bedload transport persist in the channel. No significant effects to channel morphology and hydraulic conditions are anticipated by the O&M Program's erosion protection actions on freshwater stream and tidally influenced areas because hardscape will not be used and no erosion protection will be placed in at least 80 percent of the active channel width. Stream channels and tidal sloughs at and adjacent to work sites are anticipated to continue to maintain existing features that provide complex rearing, feeding, spawning, and shelter habitat. Based on the proposed measures and limits for erosion protection activities at gas line crossings, this O&M Program element is expected to have minimal impacts on natural channel functions and habitat condition for anadromous fish in streams throughout the action area.

Riparian Vegetation

O&M Program activities at gas line crossings will result in the removal or disturbance of existing riparian vegetation. Riparian vegetation helps maintain suitable stream habitat conditions for anadromous salmonids. Riparian zones and aquatic vegetation serve important functions in stream ecosystems, such as providing shade (Poole and Berman 2001), sediment storage and filtering (Cooper *et al*. 1987, Mitsch and Gosselink 2000), nutrient inputs (Murphy and Meehan

1991), water quality improvements (Mitsch and Gosselink 2000), channel and streambank stability (Platts 1991), habitat heterogeneity (Bryant 1983, Lisle 1986, Shirvell 1990), and refugia (Bustard and Narver 1975, Wesche *et al.* 1987, Murphy and Meehan 1991). Riparian vegetation disturbance and removal can degrade these ecosystem functions and impair stream habitat. Riparian canopy is considered a primary driver of stream temperature (Poole and Berman 2001). Removal of riparian vegetation increases stream exposure to solar radiation, leading to increases in stream temperature.

Under this RGP, instream and streamside riparian vegetation will be removed from channels to facilitate maintenance activities at PG&E infrastructure. A reduced amount of riparian vegetation often leads to reduced amount of cover used by salmonids (Bisson *et al*. 1988; Bjornn and Reiser 1991) and increases in stream temperature. The effects of riparian disturbance by PG&E O&M activities are expected to be minor because the area of impact at individual work sites is relatively small and sites will be re-vegetated post-construction with appropriate native species (NOAABA-AMM-16). Furthermore, the small number of projects on streams each year (two erosion protection; two pipeline re-coatings, two pipeline replacements, and one valve recoating/replacement) are distributed throughout all the streams in the nine-county action area. This wide distribution will limit the aggregate impacts on riparian zones and no adverse effects to stream ecosystem function are anticipated over the 10-year period of this RGP. Reseeding and revegetating disturbed areas following construction will reduce impacts to largely short-term periods. Disturbed areas are expected to regain lost shading and ecosystem function within a few years following construction.

In tidally-influence areas, the O&M Program's measure to revegetate areas subject to riparian vegetation impacts applies (NOAABA-AMM-16). Regarding eelgrass, beds of this seagrass occur throughout San Francisco Bay. Eelgrass beds are comprised of dense grass-like shoots that provide year-round fish habitat in soft sediments of the lower intertidal and shallow subtidal areas, providing three-dimensional structure in sandy or muddy soft bottom habitat, adding to fish forage and rearing habitat. The O&M Program proposes to avoid activities in all eelgrass beds and will comply with the NOAA Fisheries' California Eelgrass Mitigation Policy and Implementing Guidelines (NOAA Fisheries 2014), when activities are located adjacent to eelgrass (NOAABA-AMM-07). These measures in tidal areas are expected to reduce impacts to riparian vegetation to short-term periods and avoid impacts to eelgrass.

Critical Habitat

Proposed maintenance at gas line crossings has the potential to affect critical habitat through impacts to water quality, impacts to riparian vegetation, impair natural channel processes, and reduce habitat complexity. As discussed above, work will only be performed in dry channels and effects to water quality will be limited to minor increases in turbidity when project sites are re-watered during the following wet season with rainfall. Riparian vegetation will also be impacted by construction activities; however, PG&E will replant work sites with appropriate native species post-construction to mitigate for impacts to riparian vegetation. In tidal areas, work activities will not be performed within eelgrass beds. Site-specific erosion solutions also have the potential to impact designated critical habitat by reducing instream features that provides shelter, food, and other ecosystem benefits to aquatic habitat. For erosion solutions installed by PG&E under this RGP, projects will not include hardscape in streams with CCC steelhead critical

habitat and will not exceed more than 20 percent of the active channel width. Additionally, erosion solutions will not exceed a project footprint area of 500 square feet on streams with listed anadromous salmonids. These measures are expected to largely avoid adverse effects to instream habitat and natural channel functions because no hardscape will be used and work sites are small. Fish passage will be unaffected because erosion solutions materials will be placed in the channel in a manner that does not constrict flow and will not increase water velocities. Based on the above, the effects of O&M projects at natural gas line crossings conducted by PG&E under this RGP are expected to be negligible on designated critical habitat for CCC steelhead.

2.5.2.1 Gas Pressure Limiting Station Construction

In addition to the gas line O&M activities presented above, PG&E proposes to install new pressure limiting stations on natural gas lines. A typical pressure limiting station is constructed within a footprint of approximately 250 feet by 100 feet and all stations are place in upland areas. Pressure limiting stations will not be located in tidal waters or freshwater streams. The O&M Program has proposed sufficient measures during construction activities to prevent the discharge of contaminants and disturbed sediments from entering waterways with listed anadromous fish and designated critical habitat. Accordingly, proposed O&M Program activities associated with construction of pressure limiting stations are anticipated to have no effect on listed anadromous fish or designated critical habitat.

2.5.3. Effects of O&M Activities on Access Roads

The O&M Program proposes to perform routine maintenance on roads that provide access to PG&E's natural gas and electrical infrastructure facilities. Routine road maintenance activities will primary occur in upland areas and the majority of activities will have no effect on waterways in the action area. However, there will be repair and replacement of culverts at stream crossing on non-public roadways within the nine-county Program area. The locations of culvert work at road crossings are not known at this time, but could include streams that support CCC steelhead and/or designated critical habitat for CCC steelhead. CCV steelhead, CV spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, and Southern DPS green sturgeon do not occur in freshwater streams in the action area; therefore, culvert repairs and replacements will have no effect on these four listed fish species.

As with gas line work at stream crossings, construction activities associated with culvert repairs and replacements will not occur in flowing waters on streams with CCC steelhead or their designated critical habitat. PG&E proposes to only conduct culvert maintenance activities when the work sites are naturally dry. No stream dewatering or cofferdams will be used to dewater work sites for road maintenance and culvert repair/replacement. In addition, PG&E will ensure that all culvert repair and replacements in waterways with listed anadromous fish and/or critical habitat will be designed to meet the most current NMFS guidelines for fish passage at stream crossings (NOAABA-AMM-15). Additionally, PG&E proposes to limit the number of culvert repair/replacement projects to a maximum of two per year on streams with CCC steelhead and/or critical habitat.

If temporary bridges are installed, the structure will be clear span and no effects within the channel are anticipated because the bridge ends will be placed on existing roads outside the

channel. Temporary bridges will only remain in place during O&M activities which will range from a few days to 24 weeks. As a clear span structure with no structural elements extending into the channel, stream habitat, water quality, and fish passage are expected to remain unaffected while the temporary bridge is in place. Use of a crane to place and remove the temporary bridge will also avoid disturbance of the channel.

Effects on Fish during Construction

By limiting work at culverts to periods when the work sites are naturally dry, no flowing water and no listed fish will be present during work activities. Construction activities are expected to proceed with no effects to CCC steelhead and no discharge of construction debris into flowing water because no water will be present. O&M activities would be completed prior to the return of fall/winter surface flow in freshwater streams. Thus, no impacts to CCC steelhead are expected to occur during construction activities associated with culvert repairs and replacement.

Water Quality

Post-construction, minor turbidity will occur in waters downstream of culvert work sites when the site is re-watered during the following wet season with rainfall. Some disturbed soils will be discharged into the stream, but use of erosion control measures and plantings of native vegetation are expected to minimize the mobilization of sediments from areas disturbed by construction activities. The resulting increase in turbidity levels in the waterways is expected to be minor and rapidly dissipate to ambient levels. For these reasons, the effects of O&M Program activities at culverts on water quality in the action area are expected to be negligible for CCC steelhead.

Water quality in the freshwater portion of the action area may also be affected by maintenance activities associated with roadway drainage systems. Stormwater runoff from roads drain to waterways with listed anadromous fish and designated critical habitat. These drainage systems carry tire shreds/dust with the degradation product (6PPD-quinone) from roadways to waterways. All freshwater life stages of listed salmonids within the action area are exposed to degraded water quality due to stormwater runoff from roadways, including roads used by PG&E to access their facilities. Although the O&M Program will not construct new roads, PG&E does have maintenance agreements for roads that include drainage systems. While these roads will continue to convey stormwater runoff to streams, NMFS anticipates such runoff will be unlikely to contain large amounts of toxic materials because traffic on these roads will likely be very light and may only be sporadic. As mentioned in Section 2.2.5.2 of this opinion, recent publications have identified a degradation product of tires (6PPD-quinone) as the causal factor in salmonid mortality at concentrations of less than a part per billion (Tian *et al*. 2022, Brinkmann *et al.* 2022, Tian *et al.* 2020; Peter *et al*. 2018). Access roads to PG&E facilities include both public and private ownership. Some roads are located on State and Federal lands. Road maintenance activities conducted under this RGP would not change existing ownership, vehicle traffic levels, or drainage patterns. New roadway construction is not permitted by the RGP. For these reasons, the O&M Program is not expected to contribute meaningful amounts of contaminant loading in waterways of the action area.

Stream Channel Conditions and Fish Passage

By design, bridges and culverts stabilize stream channels at road crossings and prevent lateral channel migration, effectively forcing streams into a simplified linear configuration. Without the ability to move laterally, stream channels tend to erode and deepen vertically (Leopold 1968; Dunn and Leopold 1978). The resulting channel may fail to create and maintain aquatic and riparian habitat through lateral migration, and can instead impair groundwater/stream flow connectivity and repress floodplain and riparian habitat function. Simplified stream reaches typically produce limited macroinvertebrate prey and provide poor functional habitat for rearing juvenile salmonids (Florsheim *et al*. 2008). The Program's proposed maintenance of road crossings by repairing and replacing culverts are expected to maintain the current channel alignments and maintain existing simplification of stream habitat adjacent to culverts.

Culverts can also have significant adverse effects on fish passage. Culverts commonly clog with debris, particularly when undersized. Clogged culverts can physically prevent fish and streamflow from passing at road crossings. Culverts also concentrate flow and accelerate water velocities to levels that exceed the swimming abilities of steelhead, resulting in an impediment to migration. To ensure culverts repaired and replaced by the O&M Program on streams with CCC steelhead, culverts must be designed to conform with NMFS fish passage guidelines for anadromous salmonids at stream crossings (NOAABA-AMM-15). Culvert project designs will be presented to NMFS and the Corps in Pre-Construction Notification packages for NMFS review prior to construction. Via this implementation procedure, all culvert repairs and replacements by the Program will be designed and constructed to ensure fish passage is not impaired. In some cases, the Program's repair and replacement of culverts would improve fish passage conditions over the baseline condition where existing culverts are poorly designed or undersized.

Riparian Vegetation

As described above for work activities at gas line crossings, culvert projects will result in the removal or disturbance of existing riparian vegetation. Riparian vegetation provides several essential functions to maintain suitable habitat and water quality conditions on streams with anadromous salmonids (see Section 2.5.3 of this opinion). Per NOAABA-AMM-16, the Program will revegetate culvert work sites with appropriate native plant species to compensate for riparian vegetation impacts. Revegetation actions are expected to reduce impacts to the riparian zone and restore the ecosystem functions of the riparian zone within a few years following construction. Furthermore, the small number of culvert projects on steelhead streams each year (no more than two per year) will limit the aggregate impacts on riparian zones and no adverse effects to riparian ecosystem function are anticipated over the 10-year period of this RGP.

Critical Habitat

Proposed culvert repair/replacement work has the potential to affect critical habitat through impacts to water quality, impacts to riparian vegetation, and impairment of fish passage. As presented above, work will only be performed in dry channels and effects to water quality will be limited to minor increases in turbidity when project sites are re-watered during the wet season with rainfall. Riparian vegetation will also be damaged and removed by construction activities; however, PG&E will replant work sites with appropriate native species post-construction to mitigate for impacts to riparian vegetation. Culverts constructed on streams can impair fish

passage, stream flow, and bedload transport. To ensure culvert projects do not adversely affect critical habitat, PG&E proposes to design culverts to conform with NMFS guidelines for fish passage at stream crossings. Based on the above, the effects of culvert projects conducted by PG&E under this RGP are expected to be negligible on designated critical habitat for CCC steelhead.

2.6. Cumulative Effects

"Cumulative effects" are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation [50 CFR 402.02 and 402.17(a)]. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

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

Potential non-Federal actions affecting the action area in the future could include State angling regulation changes, voluntary or State sponsored upslope habitat restoration activities, discharge of stormwater and agricultural runoff, and continued development, including building of private roads, wells, and land use change. Urban development, including rural residential and agricultural development is likely to continue throughout the greater San Francisco Bay Area. NMFS assumes the rate of such development would be similar to that observed in the last decade.

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.

The action area of this project encompasses nine counties in the San Francisco Bay Area.[8] CCC steelhead, CCV steelhead, CV spring-run Chinook salmon, Sacramento River winter-run Chinook salmon, and Southern DPS green sturgeon occur in the San Francisco Bay estuarine portion of the action area. Of these species, only CCC steelhead are present in the freshwater

[8] The nine Bay Area counties consist of Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma counties.

streams portion of the action area. All the above listed fish species have experienced serious declines in abundance, and long-term population trends suggest a negative growth rate. Human-induced factors have reduced populations and degraded habitat, which in 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. Within the Program's action area, the effects of shoreline development, bank stabilization, water development, flood control, and urbanization are evident. These activities have degraded instream habitat conditions, reduced water quality, contaminated sediment, altered the hydrology of streams, precluded access into some watersheds, and limited access in other watersheds. Drought conditions from 2012 to 2022 exacerbated these impacts by increasing water temperatures and stream-drying, limiting habitat connectivity in the freshwater portion of the action area.

As described in the Effects of the Action (Section 2.5), several proposed O&M Program activities are expected to adversely affect listed anadromous salmonids, green sturgeon, and their habitat. These activities are associated with electrical infrastructure maintenance in San Francisco Bay, and consist of the following: pile driving, cofferdam construction, permanent loss of benthic habitat, and fish collection and relocation. PG&E proposes to limit impact hammer driving and cofferdam installation to the period between June 1 and November 30 of each year (referred to as the "limited operating period" [LOP]). However, there may be some projects where the cofferdam will remain installed past November 30 and pile driving operations would also continue past November 30. Threatened green sturgeon juveniles, sub-adults and adults are present in San Francisco Bay year-round and will be subjected to adverse effects by O&M Program activities at any time of year. Listed salmon and steelhead are generally not present in the Bay until the winter and spring months; thus, PG&E Program activities that continue after November 30 will adversely affect listed anadromous salmonids. However, O&M Program activities may that may result in adverse effects only extend a maximum of six additional weeks from November 30 because work must be completed each year by January 15.

Injury or mortality of green sturgeon, steelhead, and salmon due to barotrauma will occur during the use of impact hammers at some project sites. NMFS expects the number of PG&E maintenance projects at electrical towers that create conditions with barotrauma effects will be small because the majority of pile driving work will be performed at shallow water sites that naturally dewatered at low tide (approximately 92% of the tower sites are located above MLLW). Sound levels attenuate quickly in shallow water, but some electrical tower sites are located in deeper water. When 60-inch and 72-inch piles are installed by impact hammer in water, the zone of physical injury and mortality adjacent to the pile could extend as far as 1,778 feet due to cSEL above 187 dB. The zone of physical injury and mortality will be less when smaller piles are installed by an impact hammer (see Table 7). As described above in Section 2.5.1.4, only a few listed fish are expected to incur injury or mortality from cSEL when they are continuously exposed to high underwater sound levels in this zone by multiple impact hammer pile strikes. Injury and mortality due to exposure to peak sound levels at and above 206 dB will also occur, but will not extend beyond 30 feet from a pile being installed. The area of injury or mortality associated with peak SPLs is reduced for smaller diameter steel piles.

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 15,226 feet. The zone of behavioral effects will be less for vibratory hammers. If listed green sturgeon, salmon, or steelhead were to react behaviorally to the sound produced by impact hammers or vibratory pile driving, adequate water depths and area within adjacent open waters of San Francisco Bay are expected to provide fish sufficient area to disperse. When pile driving ceases each day, elevated underwater sound levels will conclude and these habitat areas will become available again without disturbance.

Sections 2.5.1.1 and 2.5.1.2 describe the impacts associated with the installation of cofferdams, dewatering work sites, and fish collection/handling. NMFS anticipates that a very small number of green sturgeon will be collected during dewatering events and collection of listed anadromous salmonids is improbable for several reasons. First, cofferdam installation and dewatering will not be initiated after November 30 and listed salmonids are unlikely to be present prior to that time. Second, the majority of work sites where cofferdams will be deployed are located in very shallow water and the sites will naturally dewater at low tide. Closure of cofferdams during periods of low tide will avoid entrapping water and fish. Finally, although green sturgeon will be present during cofferdam construction, construction activities are likely to cause green sturgeon to flee work sites prior to closure of cofferdams. If green sturgeon are collected and relocated for cofferdam construction, they would be subject to injury but mortality is unlikely. A compilation of 10 years of reports submitted to NMFS by fishery researchers indicates collection, handling, and relocation of green sturgeon by qualified biologists rarely results in mortality.

Benthic habitat will be disturbed by Program activities at work sites during construction. Temporary mats will be placed on the substrate to create a work area for personnel and equipment. Barges would temporarily rest on the bottom at low tide. Areas internal to cofferdams will be dewatered and subjected to disturbance by equipment and personnel. These impacts are expected to be temporary disturbance that will recover rapidly following O&M activities due to the small footprint of individual work sites and limited to the surface of the substrate. Any elevated levels of turbidity during disturbance of the substrate are anticipated to not extend beyond one or two tide cycles. Upon removal of cofferdams, mats, and work barges, minimal changes to the surface elevation of the bottom are expected. For these reasons, the potential effects of localized areas of elevated turbidity and benthic habitat disturbance associated with O&M Program activities in San Francisco Bay are expected to be negligible for ESA-listed fish. Permanent loss of benthic habitat is expected when tower footings and foundations are re-located, but the overall area impacted by the program is estimated to be very small (0.08 acres per year) and not adversely affect prey availability and foraging by listed fish. At some sites, abandoned footings and piles will be removed and result in no net increase in the extent of fill in the Bay.

In waterways upstream from San Francisco Bay, freshwater streams with threatened CCC steelhead and designated critical habitat will be affected by the O&M Program's maintenance activities at natural gas line crossings and culvert repair/replacements on access roads. PG&E will only perform work in these stream channels when work sites are seasonally dry. With no flowing water during these construction and maintenance activities, no effects to threatened CCC steelhead are anticipated during construction. The program has also incorporated measures including no placement of new hardscape materials, replanting of native riparian vegetation, and annual limits upon the number and size of projects to ensure O&M activities do not adversely affect steelhead habitat in streams of the action area. Culvert repairs and replacements will be designed to conform with NMFS guidelines for fish passage at stream crossings.

Designated critical habitat for Southern DPS green sturgeon, CCC steelhead, and Sacramento River winter-run Chinook salmon occurs in the action area. While conditions vary across the DPSs, critical habitat is generally impaired by channel modification, habitat alteration and fragmentation, dams and water diversions, groundwater extraction, and estuarine habitat loss. These factors also affect designated critical habitat in the action area of this project.

The estuarine portion of the action area includes areas designated as critical habitat for Southern DPS green sturgeon, CCC steelhead, and Sacramento River winter-run Chinook salmon. Effects to critical habitat in San Francisco Bay include temporary degradation of water quality, benthic disturbance, and elevated levels of underwater sound. A small amount of benthic habitat at widely dispersed sites is also expected to be permanently lost due to relocation or replacement of electrical tower foundations and pilings; however, these permanent impacts to benthic habitat are not expected to exceed 0.08 acre per year at all work sites combined.

Within the freshwater portion of the action area, several streams are designated critical habitat for CCC steelhead. O&M Program activities will affect freshwater CCC steelhead critical habitat at gas line crossings and culverts on streams; however, proposed measures at stream crossing are anticipated to avoid adverse effects to CCC steelhead critical habitat. Measures include prohibiting use of hardscape for erosion protection, limiting the extent of scour protection to not exceed 20 percent of the channel width, and all culverts will be designed to provide unimpeded fish passage by conforming with NMFS guidelines for salmonid passage at stream crossings. The O&M Program will maintain access roads, including existing drainage systems that convey stormwater runoff from roadways. PG&E's maintenance of stormwater drainage on some of these roads is unlikely to meaningfully increase the amount of contaminants from roadways to streams. After considering the O&M Program's measures for work in streams with CCC steelhead critical habitat, NMFS concludes that the value of critical habitat as a whole for species conservation will not be appreciably reduced.

Regarding future climate change effects in the action area, California could be subject to higher average summer air temperatures and lower total precipitation levels. The Sierra Nevada snow pack is likely to decrease by as much as 70 to 90 percent by the end of this century under the highest emission scenarios modeled. Reductions in the amount of rainfall would reduce stream flow levels in rivers of the action area. Estuaries may also experience changes in productivity due to changes in freshwater flows, nutrient cycling, and sediment amounts. California's most recent period of drought began in approximately 2012. This 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*. 2019, Williams *et al.* 2020, Williams *et al*. 2022, Diffenbaugh *et al*. 2015,). For PG&E's O&M Program, the immediate effects of construction activities would occur over the next five to 10 years, and the long-term effects of climate change are unlikely to be detected within this time frame. If these effects of climate change are detected over the short term, they will likely materialize as moderate changes to the current climate conditions with the action area. These changes may place further stress on ESA-listed fish populations. Most of the effects of the proposed action are likely to occur during these nearer term climate change effects (droughts with occasional years of heavy rainfall) as described in the Environmental Baseline Section of this opinion (Section 2.4). Long-term impacts from the proposed action are limited to very small areas of permanent habitat loss in the action area and, thus are unlikely to exacerbate the impacts of climate change on listed species and their critical habitat. Considering the above, we do not expect climate change to alter conditions in the action area beyond the scope already considered in this opinion.

While PG&E's O&M Program will result in adverse effects to listed fish during pile driving and cofferdam construction, we expected these losses to be very small fraction of the ESU and DPS populations. Benthic habitat losses due to new and expanded tower foundations and pilings are also expected to be very small (0.08 acres year) in relation to the amount of estuarine habitat area in San Francisco Bay. In consideration of the O&M Program's proposed avoidance and minimization measures (Section 1.3.5 of this opinion), actions conducted by PG&E in freshwater streams will avoid adverse effects to listed CCC steelhead. Culvert projects on streams will be designed to conform with NMFS guidelines for fish passage at stream crossings and these upgrades may improve existing passage conditions for steelhead, particularly at undersized culverts. NMFS does not expect any of the aforementioned effects of PG&E's O&M Program to combine with other effects in any significant way. Effects from proposed activities under the RGP are limited in time and area, and anticipated adverse effects are minimal and only affect a small number of listed fish during the five to 10-year period of this RGP. Ultimately, the effects of the proposed activities that would be conducted under this RGP, when added to the environmental baseline, cumulative effects, and species status, are not expected to appreciably reduce the likelihood of survival or recovery of listed salmonids and green sturgeon, nor does it appreciably degrade the value of their critical habitat.

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 PG&E O&M Program is not likely to jeopardize the continued existence of threatened CCC steelhead, threatened CCV steelhead, threatened CV spring-run Chinook salmon, endangered Sacramento River winter-run Chinook salmon, and threatened Southern DPS green sturgeon or destroy or adversely modify designated critical habitat for CCC steelhead, Sacramento River winter-run Chinook salmon, and Southern DPS green sturgeon.

2.9. Incidental Take Statement

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

2.9.1. Amount or Extent of Take

In this opinion, NMFS determined that incidental take of threatened CCC steelhead, threatened CCV steelhead, threatened CV spring-run Chinook salmon, endangered Sacramento River winter-run Chinook salmon, and threatened Southern DPS green sturgeon in the form of injury, harm, or mortality is reasonably certain to occur in association with impact hammer pile driving in San Francisco Bay. Additionally, the incidental take of Southern DPS green sturgeon will occur during fish collection and relocation associated with cofferdam construction.

For impact hammer pile driving, NMFS is not able to estimate the specific number of CCC steelhead, CCV steelhead, CV spring-run Chinook salmon, winter-run Chinook salmon, and green sturgeon that will be incidentally taken by elevated underwater sound levels due to the large geographic scope of the action area, varying environmental conditions between project sites, and the number of proposed sites for the Program. Additionally, monitoring or measuring the number of listed fish actually injured or killed by elevated sound levels during pile driving is also not feasible. Injured or killed fish are unlikely to be observed because they may not float to the surface or may be carried away by strong currents in portions of the action area. Due to the difficulty in quantifying the number of listed fish that could be injured or killed by pile driving, a surrogate measure of incidental take is necessary to establish a limit to take exempted by this incidental take statement. NMFS will therefore use the following incidental take surrogate pursuant to 50 CFR 402.14(i)(1)(i) for elevated underwater sound levels during impact hammer pile driving:

The extent of incidental take will be considered exceeded if elevated sound levels during pile driving are greater than 206 dB peak or 187 dB cSEL at the following specified distances for each steel pile size:

Steel Pile Size	Distance (ft) to 206 dB peak	Distance (ft) to 187 dB accumulated SEL/day
16-inch	0	30
20-inch	20	446
24-inch	10	552
36-inch	20	827
60-inch	30	1,778
72-inch	30	1,309

For cofferdam construction, NMFS is not able to estimate the specific number of Southern DPS green sturgeon that will be collected and relocated during construction of cofferdams; however, it is expected to be a low number of individual fish during implementation of O&M Program activities for the reasons presented above in this opinion.

Unintentional injury of green sturgeon during capture, handling, and relocation will occur; however, mortality is unlikely absent an unintentional accident. The amount of incidental take during dewatering and fish relocation will be considered exceeded if more than one green sturgeon is killed during dewatering and fish relocation activities.

2.9.2. Effect of the Take

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

2.9.3. Reasonable and Prudent Measures

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

NMFS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of listed fish:

1. Undertake measures to ensure that harm and mortality to listed fish resulting from fish relocation and dewatering activities is low.
2. Ensure proposed culvert repair and replacement actions are designed to provided unimpeded fish passage.
3. Prepare and submit post-construction reports for each O&M program activity that includes cofferdam construction in San Francisco Bay and/or pile driving with an impact hammer on steel piles 20 inches or greater in diameter.
4. Prepare and submit annual reports for O&M program activities performed on streams with listed anadromous salmonids and/or designated critical habitat.

2.9.4. Terms and Conditions

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

1. The following terms and conditions implement reasonable and prudent measure 1:

   a. PG&E shall retain qualified fisheries biologist(s) with expertise in the areas of identification, handling, collecting, and relocating anadromous fish species to oversee cofferdam construction and fish relocation at work sites in San Francisco Bay. The qualified biologist(s) must be on site during all dewatering events to capture, handle, and safely relocate ESA-listed fish.

   b. Biologists shall conduct fish collections in a manner which minimizes potential risks to ESA-listed fish. The biologist must monitor construction sites during placement and removal of cofferdams to ensure that any adverse effects to listed fish are minimized.

   c. ESA-listed fish shall be handled with extreme care and kept in water to the maximum extent possible during rescue activities. Captured fish will be relocated, as soon as possible, to a location with suitable habitat conditions.

   d. If any salmonids or sturgeon are found dead or injured, the biologist shall contact NMFS biologist Sara Azat by phone at 707-575-6067, by email at sara.azat@noaa.gov or the NMFS Santa Rosa Area Office at 707-387-0737. The purpose of the contact is to review the activities resulting in take and to determine if additional protective measures are required. All mortalities of listed fish must be retained. Tissue samples are to be acquired from each mortality per the methods identified in the NMFS Southwest Fisheries Science Center Genetic Repository protocols (contact the above NMFS office at the phone number provided) and sent to: NOAA Coastal California Genetic Repository, Southwest Fisheries Science Center, 110 McAllister Way, Santa Cruz, CA 95060.

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

   a. The Corps or PG&E shall submit draft design plans for projects that include culvert repair or replacement on streams with listed anadromous fish to NMFS for review and approval at least 120 days prior to construction. Design plans are to be submitted to NMFS North Central Coast Office, Attention: San Francisco Bay Branch Chief, 777 Sonoma Avenue, Room 325, Santa Rosa, California 95404-6528.

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

   a. PG&E shall provide a written post-construction report to NMFS within 60 days of completion of work for each project site in San Francisco Bay that includes cofferdam construction and/or driving of steel piles 20 inches or greater in diameter. The report must include the following information:

      - Summary of construction activities, including: dates construction began and ended; use of a cofferdam and 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.

      - Summary of fish relocation activities, including: the number of fish collected by species; the condition of fish at the time of release; the number and species of fish injured or killed; description of the equipment and methods used to collect, hold, and transport fish; and a description of any problems which may have arisen during the relocation activities and a statement as to whether or not the activities had any unforeseen effects.

      - Summary of pile driving activities and hydroacoustic monitoring, including: size and number of piles installed by impact hammer; results of hydroacoustic monitoring, if any was performed; functionality of air bubble curtain, if any was used; and a description of any problems which may have arisen during the pile driving and associated unforeseen effects.

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

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

   a. PG&E shall include the following additional information in the annual reports to NMFS (to be submitted on March 31 per BA-AMM-03):

      - Summary of construction activities at gas line crossings and access roads (*i.e.*, culvert repair/replacements), including: dates construction began and ended; measures to protect riparian habitat and riparian revegetation; a description of the minimization measures taken to address any unanticipated issues; photographs pre-, during, and post-construction; and any other relevant information.

   b. Annual reports are to be submitted to NMFS North Central Coast Office, Attention: San Francisco Bay Branch Chief, 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 recommends that hydroacoustic monitoring be performed at all sites that utilize an impact hammer on steel piles greater than 20-inches in diameter to improve the breadth of information related to elevated underwater sound levels during pile driving in the San Francisco Bay.

2.11. Reinitiation of Consultation

This concludes formal consultation for the PG&E's Bay Area Operation and Maintenance Program.

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

2.12. Not Likely to Adversely Affect" Determinations

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. 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 (50 CFR 402.02). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b). When evaluating whether the proposed action is not likely to adversely affect listed species or critical habitat, NMFS considers whether the effects are expected to be completely beneficial, insignificant, or discountable. Completely beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Effects are considered discountable if they are extremely unlikely to occur.

2.12.1. Background and Action Agency's Effects Determination

The Corps has determined that the proposed action is not likely to adversely affect the following species and critical habitat (Evolutionarily Significant Units [ESU]) or (Distinct Population Segments [DPS]) under the jurisdiction of NMFS:

California Coastal (CC) Chinook salmon ESU (*Oncorhynchus tshawytscha*)
Threatened (70 FR 37160; June 28, 2005)
Critical habitat (70 FR 52488; September 2, 2005);

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

Central California Coast (CCC) coho salmon ESU (*Oncorhynchus kisutch*)
Endangered (70 FR 37160, June 28, 2005)
Critical habitat (64 FR 24049; May 5, 1999).

The life history of Chinook salmon is summarized in Myers *et al.* (1998) and the most recent NMFS status review (NMFS 2016e). The CC Chinook salmon ESU are typically fall spawners, entering their natal streams in the early fall. Adults tend to spawn in the mainstem or larger tributaries of rivers, and eggs are deposited in redds for incubation. When the 0+ age fish emerge from the gravel in the spring, they typically migrate to salt water shortly after emergence. Prey resources during early freshwater rearing and out-migration are critical to Chinook salmon survival as they grow and move out to the open ocean.

The life history of steelhead is summarized in Busby *et al.* (1996) and the most recent NMFS status review (Williams *et al*. 2016). S-CCC Steelhead are anadromous forms of *Oncorhynchus mykiss,* spending some time in both fresh- and saltwater. Juveniles – typically in spring as smolts – migrate to the ocean where they mature. Adult steelhead return to freshwater rivers and streams to reproduce, or spawn. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning in multiple years before death (Busby *et al.* 1996; Moyle 2002). Within the S-CCC steelhead DPS, adults typically enter freshwater between December and April, with peaks occurring in January through March (Fukushima and Lesh 1998). Eggs (laid in gravel nests called redds), alevins (gravel dwelling hatchlings), fry (juveniles newly emerged from stream gravels), and other juvenile life stages all rear in freshwater until they migrate to the ocean where they reach maturity.

The life history of coho salmon in California is summarized by NMFS (1995; 2016f). Coho are also anadromous salmonids, spending some time in both freshwater and saltwater. In California coastal streams, adult coho salmon upstream migration occurs between November and February, and smolt outmigration occurs between March and June, peaking March through May (Fukushima and Lesh 1998). CCC coho salmon were historically abundant in the Russian River and tributaries. Presently, however, coho are rare throughout the action area.

Critical habitat for CC Chinook, S-CCC steelhead, and CCC coho salmon is present in the action area. The PBFs of designated critical habitat for CC Chinook salmon and S-CCC steelhead in 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.

For CCC coho salmon critical habitat, the following essential habitat types were identified: 1) juvenile summer and winter rearing areas; 2) juvenile migration corridors; 3) areas for growth and development to adulthood; 4) adult migration corridors; and 5) spawning areas. Within these areas, essential features of coho salmon critical habitat includes adequate: 1) substrate, 2) water quality, 3) water quantity, 4) water temperature, 5) water velocity, 6) cover/shelter, 7) food, 8) riparian vegetation, 9) space, and 10) safe passage conditions (64 FR 24029).

2.12.2. Effects of the Action

As described in Section 2.5.1 of this opinion, the O&M Program includes maintenance of electrical transmission lines that are supported by steel-lattice towers, steel poles, and wooden poles. The majority of PG&E's electrical infrastructure in the Bay Area is located in terrestrial areas. Electrical infrastructure facilities to be maintained by the proposed O&M Program in tidal waters are limited to San Francisco Bay. Threatened CC Chinook salmon, threatened S-CCC steelhead, endangered CCC coho salmon, and their designated critical habitat are not present in San Francisco Bay.

In the freshwater portion of the action area, no electrical infrastructure is located in freshwater streams and no electrical infrastructure maintenance would be conducted in streams. Measures proposed by PG&E in terrestrial areas during work on electrical towers and poles are expected to prevent the degradation of water quality in streams with listed anadromous fish. Thus, electrical tower and pole repairs/replacements in terrestrial areas are anticipated to have no effect on threatened CC Chinook salmon, threatened S-CCC steelhead, endangered CCC coho salmon and their designated critical habitat.

Within the action area, PGE&E O&M Program activities that will affect threatened CC Chinook salmon, threatened S-CCC steelhead, and endangered CCC coho salmon are associated with

natural gas line maintenance and culvert repair/replacements on freshwater streams. Natural gas system O&M activities are described in Section 1.3.3 of the opinion. At stream crossings with listed anadromous fish, these activities consist of site-specific erosion measures over pipelines, pipeline recoating, pipeline replacement, valve recoating, and valve replacement. Proposed maintenance activities at access roads are described in Section 1.3.4 of the opinion. For access road maintenance at stream crossings with listed anadromous fish, the Program proposes to repair and replace culverts.

Table 5 of the opinion presents the known streams with listed anadromous fish and/or designated critical habitat in the action area where PG&E gas line activities may occur. There may be additional gas line crossings on streams with listed anadromous fish in the action area that were not identified by PG&E during consultation and are not listed in Table 5. For road maintenance work on culverts, the location of these stream crossing activities could occur throughout the nine-county O&M Program area, including sites on streams with listed anadromous fish and/or critical habitat. During implementation of the RGP, PG&E's pre-construction notifications for individual O&M activities will identify specific locations and specify whether or not listed anadromous fish or designated critical habitat may be present at work sites.

The proposed O&M activities associated with gas line infrastructure generally involve the excavation of soils to expose the gas line or valve, performing the recoating or replacement work (valve or pipeline), and then replacing the excavated materials to re-bury the pipeline. For site-specific erosion protection, biodegradable jute netting and other non-hardscape materials will be placed on exposed sections of pipeline in the stream channel to prevent further erosion. PG&E proposes to limit O&M activities associated with gas line crossings at waterways with listed anadromous fish to periods when the work sites are naturally dry (see NOAABA-AMM-13). By restricting gas line maintenance to sites that are naturally dry, no dewatering with cofferdams will be required and the potential adverse effects associated with excavation and trenching in wetted areas will be avoided. Similarly, proposed repair and replacement of culverts on streams with listed anadromous fish, will only be conducted by PG&E when work sites are naturally dry.

Sections 2.5.3 and 2.5.4 of the opinion present the potential effects of gas line O&M activities and culvert maintenance on freshwater streams with threated CCC steelhead and their designated critical habitat. These effects also apply to threatened CC Chinook salmon, threatened S-CCC steelhead, and endangered CCC coho salmon. With no flowing water present during work at sites on freshwater streams during O&M Program activities, no listed salmon or steelhead will be present and no effects during construction are expected. Post-construction, minor turbidity will occur in waters at work sites when the site is re-watered during the following wet season with rainfall, but use of erosion control measures and plantings of native vegetation are expected to minimize the mobilization of sediments from areas disturbed by construction activities. For these reasons, the effects of O&M activities at gas line infrastructure and culvert repair/replacement sites on water quality and riparian vegetation are expected to be insignificant for CC Chinook salmon, S-CCC steelhead, and CCC coho salmon.

Proposed site-specific erosion solutions on exposed gas line crossing have the potential to prevent lateral channel migration, effectively forcing streams into a simplified linear configuration. Simplified stream reaches typically produce limited macroinvertebrate prey and

provide poor functional habitat for rearing juvenile salmonids (Florsheim *et al*. 2008). Meandering streams create and maintain both the hydraulic and physical components of healthy instream habitat used by fish and other aquatic species (Spence *et al.* 1996). For erosion protection actions authorized by this RGP in waterways with listed anadromous fish, PG&E will not utilize any hardscape materials. Erosion protection materials will include jute netting, straw waddles, native plants, and hydroseeding. Materials will be placed in the channel to avoid constricting flow and not increase water velocities in the channel. Additionally, erosion protection projects will not span more than 20 percent of the active channel width and not exceed 500 square feet per site (NOAABA-AMM-14). These measures will significant limit the extent of impacts on channel morphology and stream hydraulics. The 20 percent channel width limit, combined with placement of materials to not constrict flow nor increase water velocities, will ensure fish passage is unaffected and the channel maintains existing features that provide complex rearing, feeding, spawning, and shelter habitat. On average, only two site-specific erosion protection projects would be performed per year in anadromous salmonid streams throughout the nine-county action area. Based on the proposed measures and limits for erosion protection activities at gas line crossings, the effects of this O&M Program element are expected to be insignificant on CC Chinook salmon, S-CCC steelhead, and CCC coho salmon.

Culverts can impair fish passage, streamflow and bedload transport in streams. To ensure all culvert projects on streams with listed anadromous salmonids do not produce adverse effects, PG&E proposes to design culverts to conform with NMFS guidelines for fish passage at stream crossings (NOAABA-AMM-15). Culvert project designs will be presented to NMFS and the Corps in Pre-Construction Notification packages for NMFS review prior to construction. Via this implementation procedure, all culvert repairs and replacements by the Program will be designed and constructed to ensure fish passage is not impaired, and streamflow and bedload transport are unimpeded. In some cases, the Program's repair and replacement of culverts would improve fish passage conditions over the baseline condition at existing undersized culverts. For these reasons, the effects of O&M activities at culverts on fish passage and streams in the action area are expected to be insignificant on CC Chinook salmon, S-CCC steelhead, and CCC coho salmon.

The action area is located within designated critical habitat for CC Chinook salmon, S-CCC steelhead, and CCC coho salmon. Effects to designated critical habitat will include minor levels of turbidity post-construction, channel and habitat impairment from erosion solutions, and fish passage impairment at culverts. For reasons presented above, these construction and post-construction effects on designated critical habitat are expected to be insignificant.

2.12.3. Conclusion

Based on this analysis, NMFS concurs with the Corps that the proposed action is not likely to adversely affect the subject listed species and designated critical habitats.

2.12.4. Reinitiation of Consultation

Reinitiation of consultation is required and shall be requested by the Corps or by NMFS, where discretionary Federal involvement or control over the action has been retained or is authorized by law and (1) the proposed action causes take; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;

(3) 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 written concurrence; or (4) a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR 402.16).

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

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

This analysis is based, in part, on the EFH assessment provided by the Corps and descriptions of EFH for 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 Secretary of Commerce.

3.1. Essential Fish Habitat Affected by the Program

The Corps 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 O&M activities to result in disturbance of benthic habitat, increased turbidity, increased in-water sound and vibration, and other adverse effects to water quality. In addition, the Program action area includes areas designated as Habitat Areas of Particular Concern (HAPC) for various species of fish with the Pacific Coast Groundfish and Pacific Coast Salmon FMPs; estuaries and eelgrass are designated HAPC for both FMPs.

3.2. Adverse Effects on Essential Fish Habitat

NMFS has 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 sound, (2) disturbance to benthic

habitat, (3) impacts to water quality in the form of increased turbidity in the water column and suspension of sediments, (4) stream channel disturbance during repair and replacement gas lines at stream crossings, and (5) impacts to water quality associated with access road maintenance.

EFH may also be temporarily impacted by dewatering of construction areas in San Francisco Bay. Culvert repair and replacements in streams throughout the action area may have beneficial effects on EFH for Pacific Coast Salmon by upgrade passage conditions. The short-term and long-term effects of the Bay Area O&M Program's activities on EFH for the Pacific Coast Groundfish and Coastal Pelagic FMPs are generally the same as that presented in Section 2.5.1.8 of this opinion for designated critical habitat for the Southern DPS of green sturgeon. Effects to EFH for the Pacific Coast Salmon FMP are generally the same extent and type as described in Section 2.5.1.8 of this opinion for CCC steelhead designated critical habitat.

3.3. Essential Fish Habitat Conservation Recommendations

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

The Corps and PG&E should avoid and minimize adverse effects of EFH quantity and quality by:

1. follow Term and Condition #2(a) from the ITS in Section 2.9.2 above;
2. complete the monitoring and reporting described in Terms and Conditions #3(a), 3(b) 4(a) and 4(b) from the ITS in Section 2.9.2 above; and
3. follow the ESA conservation recommendation described in Section 2.10 above.

3.4. Statutory Response Requirement

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

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

3.5. Supplemental Consultation

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

4. DATA QUALITY ACT DOCUMENTATION AND PRE-DISSEMINATION REVIEW

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

4.1. Utility

Utility principally refers to ensuring that the information contained in this consultation is helpful, serviceable, and beneficial to the intended users. The intended users of this opinion are the Corps. Other interested users could include PG&E, California Department of Fish & Wildlife, San Francisco Bay Conservation and Development Commission, and San Francisco Bay Regional Water Quality Control Board. Individual copies of this opinion were provided to the Corps and PG&E. The document will be available within 2 weeks at the NOAA Library Institutional Repository [https://repository.library.noaa.gov/welcome]. The format and naming adhere to conventional standards for style.

4.2. Integrity

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

4.3. Objectivity

Information Product Category: Natural Resource Plan

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

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

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

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

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